THE FEDERAL DEMOCRATIC REPUBLIC OF

ETHIOPIA

ETHIOPIAN ROADS AUTHORITY

Standard Detailed Drawings

for Roadworks

2013

Foreword

The road network in Ethiopia provides the dominant mode of freight and passenger transport and thus plays a vital role in the economy of the country. The network comprises a huge national asset that requires adherence to appropriate standards for design, construction and maintenance in order to provide a high level of service. As the length of the road network is increasing, appropriate choice of methods to preserve this investment becomes increasingly important.

In 2002, the Ethiopian Roads Authority (ERA) first brought out road design manuals and standard technical specifications and drawings to provide a standardised approach for the design, construction and maintenance of roads in the country. Due to technological development and change, these manuals, specifications and drawings require periodic updating. This current version of the standard detailed drawing for roadworks has been updated taking due consideration of the revisions incorporated into the prevailing version of the various road design manuals and standard specifications that make particular reference to the prevailing conditions in Ethiopia and reflects the experience gained through activities within the road sector during the years since 2002. Completion of the review and updating of the various documents and drawings was undertaken in close consultation with the federal and regional roads authorities and the stakeholders in the road sector including the contracting and consulting industry.

Most importantly, in supporting the preparation of the documents, a series of thematic peer review panels were established that comprised local experts from the public and private sector who provided guidance and review for the project team.

These standard detailed drawings supersede the ERA Standard Detailed Drawings of 2002.

On behalf of the Ethiopian Roads Authority I would like to take this opportunity to thank JICA, DFID and the AFCAP team for their cooperation, contribution and support in the revision of the manuals, specifications and drawings for Ethiopia. I would also like to extend my gratitude and appreciation to all of the industry stakeholders and participants who contributed their time, knowledge and effort during the development of the documents, specifications and drawings. Special thanks are extended to the members of the Peer Groups whose active support and involvement guided the revision of the drawings and the process in general.

It is my sincere hope that these drawings in association with the various design manuals, specifications and bidding documents will provide all users with both a standard reference and a ready source of good practice for the design, construction and maintenance of roads, and will assist in a safe, cost effective operation, and environmentally sustainable development of our road network.

I look forward to the practices contained in the manuals, specifications and drawings being quickly adopted into our operations, thereby making a sustainable contribution to the improved infrastructure of our country.

Comments and suggestions are expected on all aspects of these drawings from any concerned body, group or individual as feedback during their implementation and will be highly appreciated.

Addis Ababa, 2013
Zaid Wolde Gebriel
Director General, Ethiopian Roads Authority

Preface

The Ethiopian Roads Authority is the custodian of the series of technical manuals, standard specifications, drawings and bidding documents that are produced for the practicing Engineer in Ethiopia. The series of documents describes current and recommended practice and sets out the national standards for roads and bridges. The manuals are based on national experience and international practice and are approved by the Director General of the Ethiopian Roads Authority.

The prevailing version of the *Standard Detailed Drawings* forms part of this series. The complete series of documents, covering all road and bridge works in Ethiopia, are contained within the prevailing versions of the following:

1. Geometric Design Manual
2. Site Investigation Manual
3. Geotechnical Design Manual
4. Route Selection Manual
5. Pavement Design Manual Volume I Flexible Pavements
6. Pavement Design Manual Volume II Rigid Pavements
7. Pavement Rehabilitation and Asphalt Overlay Design Manual
8. Drainage Design Manual
9. Bridge Design Manual
10. Low Volume Roads Design Manual
11. Standard Environmental Procedures Manual
12. Standard Technical Specifications and Methods of Measurement for Roadworks
13. Standard Detailed Drawings
14. Standard Bidding Documents for Road Work Contracts – A series of Bidding Documents covering a full range from large scale projects unlimited in value to minor works with an upper threshold of $300,000. The higher level documents have both Local Competitive Bidding and International Competitive Bidding versions

These documents are available to registered users through the ERA website: www.era.gov.et

Updates

The Standard Detailed Drawings will be updated and revised from time-to-time as deemed appropriate.

Significant changes to criteria, procedures or any other relevant issues related to new policies; or revised laws of the land; or that is mandated by the relevant Federal Government Ministry or Agency, should apply to the drawings from their date of effectiveness.

Other minor changes that will not significantly affect the whole nature of the drawings contained herein will be accumulated and included in subsequent revisions of the drawings. Changes of this nature should be incorporated into Particular or Project Specifications and Drawings until a new revision has been published.

All suggestions to improve the drawings should be made in accordance with the following procedures:

1. Users of the drawings must register on the ERA website: www.era.gov.et
2. Proposed changes should be outlined on the Manual Change Form and forwarded with a covering letter of its need and purpose to the Director General of the Ethiopian Roads Authority.
3. The proposed modifications will be assessed by the requisite authorities in ERA in close consultation with an Executive Review Group of relevant stakeholders.
4. Agreed changes will be approved by the Director General of the Ethiopian Roads Authority on recommendation from the Deputy Director General (Engineering Operations).
5. All approved changes to the drawings will be communicated to all registered users of the specifications and posted on the web site. In addition, all affected drawings will be re-issued with the approved revision date emanating from the Specification Change Form 1-1.

ETHIOPIAN ROADS AUTHORITY
STANDARD DETAILED DRAWINGS

DRAWING CHANGE		This area to be completed by the ERA Director of Quality Assurance
		CHANGE NO._____ (SECTION NO. CHANGE NO. _____
Drawing Number	**Explanation**	**Suggested Modification**

Submitted by: Name:_____

Designation:_____

Company/Organisation Address

_____

_____email:_____Date:_____

Manual Change Action

Authority	Date	Signature	Recommended Action	Approval
Registration				
Director Quality Assurance				
Deputy Director General Eng.Ops				

Approval / Provisional Approval / Rejection of Change:

Director General ERA**:**_____ **Date:** _____

Acknowledgements

The Ethiopian Roads Authority (ERA) wishes to thank the UK Government's Department for International Development (DFID) through their Africa Community Access Programme (AFCAP) and the Japan International Cooperation Agency (JICA) for their support in developing the Standard Detailed Drawings which will be used by all authorities and organisations responsible for the provision of roads in Ethiopia.

This prevailing version of the Standard Detailed Drawings is based on a review of local and international procedures and is complimentary to the updated and revised suite of ERA Design Manuals and Standard Specifications.

From the outset, the approach to the development of the manuals, specifications and drawings was to include all sectors and stakeholders in Ethiopia. The input from the international team of experts was supplemented by our own extensive local experience and expertise. Local knowledge and experience was shared through review workshops to discuss and debate the contents of the draft manual and subsequent specifications and drawings. ERA wishes to thank all the individuals who gave their time to attend the workshops and provide valuable inputs to the revision of the drawings.

A Peer Group comprising specialists drawn from within the local industry was established to provide advice and comments in the specialists' respective areas of expertise. The contribution of the Peer Group participants is gratefully acknowledged.

The final review and acceptance of the document was undertaken by an Executive Review Group. Special thanks are given to this group for their assistance in reviewing the final drafts of the drawings.

Finally, ERA would like to thank AFCAP Core Management Group for their overall management of the project.

Executive Review Group		
No.	**Name**	**Organization**
1	Ato Bekele Jebessa	Ethio Infra Engineering plc

List of Persons Contributing to Peer Group Review		
No.	**Name**	**Organization**
1	Ato Abebe Assefa	Ethiopian Roads Authority
2	Ato Ahmed Mohammed	Associated Engineering Consultants
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2	Abdo Mohammed	ERA	Project Coordinator
3	Frew Bekele	ERA	Project Coordinator
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5	Les Sampson	AFCAP/Crown Agents	Project Director/Lead Author
6	Brian Barr	AFCAP/Crown Agents	Specialist Contributor

Addis Ababa, 2013

Zaid Wolde Gebriel
Director General, Ethiopian Roads Authority

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General Notes for Bridges

It is mandatory that the following notes be carefully read and fully understood, and that all provisions there in be complied with strictly.
The user of these Standard Drawing shall check the detail drawing based on his own structural computation and confirm the sufficiency of the section and reinforcement bar for the intended purpose.

No work on any item shall be permitted to start until the contractor has on the job, ready for use, the equipment and materials as specified. Particular attention is directed to reinforcing steel, mechanical compaction in 15cm. Horizontal layers behind wing walls and abutment, and rubbing of exposed concrete surfaces with carborundum stones, as outlined below.

Required special materials and equipment such as for lines, standby mixer, vibrator, bar supports, carborundum stones, finishing brushes, mechanical tampers, etc shall be made available before starting of work. All in good condition and ready for use. Any operation found to be proceeding not in accordance with these provisions shall be suspended immediately. Any work accomplished not in accordance with these provision shall be classified as defective workmanship. It shall be satisfactorily corrected, or removed and reconstructed, before any further work on the item concerned is authorized to proceed. No delays in connection with compliance with these provisions shall be eligible for an extension of contract time except accidents classifiable as force majeure.

DESIGN SPECIFICATION THE PREVAILING VERSIONS OF THE ERA BRIDGE DESIGN MANUAL AND AASHTO LRFD Bridge Design Specification

DESIGN LOADING:– HL 93

REINFORCING STEEL :–
Reinforcing steel shall be deformed bars of minimum yield strength 400MPa for diameter 20 and above and 300MPa for diameter less than 20mm. Splices shall be staggered, with at least 1.5m distance between splices of adjacent reinforcement bars.

FORMS FOR EXPOSED CONCRETE SURFACES : –
Forms for permanently exposed concrete surfaces shall be lined with plywood masonite or other approved form.

The form liner material shall be free of wrinkles, warping, open joints and other surfaces imperfections at the time of pouring. Form liners will not be required for bottom of slabs, interior girders and inside faces of exterior girders. No other exceptions.

Make sure that the false work used are properly designed and erected to avoid settlement during concrete casting.

RUBBED FINISH FOR EXPOSED CONCRETE SURFACES :–
All permanently exposed concrete surfaces (except bottom and interior girder surfaces) shall be given a rubbed finish using carborundum or equivalent abrasive stones, water and brush. The procedure is as follows:– thoroughly wet the surface to be rubbed and keep it wet. Fill all surface voids with cement mortar, rub by hand with carborundum stone using a short, circular motion. When irregularities have been removed and a uniform texture obtained, smooth the wet surface with the brush using a light, horizontal stroke. Do not rub off the powder when the surface is dry. Repeat the process when dried, until the surface is smooth or is of uniform colour texture. The brush may be of the type used for wall painting and shall be at least 10cm wide.
A proper rubbed finish becomes more difficult as the concrete hardens.
Hence it should be executed as soon as there is no danger of damaging finished work by spillage from ongoing concrete work.

CONCRETE:

All concrete, unless otherwise indicated, CLASS A, with the characteristic compressive strength (150ml cylinders) of 24MPA. (C–30) And as per technical specifications.

Use the necessary vibrating equipment during concrete casting and provide sufficient space for the vibrating and/or concrete pump hose between closely spaced reinforcement bar.
The supervisor shall strictly follow and control these activities with proper curing for seven days (concrete shall be contineously wet with in these days).

CHAMFERS:

All concrete edges shall be chamfered 2.5cm, measured along the face of chamfer, unless otherwise shown on the plans. Attention is directed to the fact that this requirement shall apply to all concrete edges, whether or not the chamfers are shown on the plan details.

CONSTRUCTION SPECIFICATIONS:–

Bidding document technical specifications,

EXPANSION JOINT FILLER:–

Performed expansion joint filler shall be bituminous type meeting the requirements of ASTM.D994 unless otherwise shown or noted.

BACKFILLING AND COMPACTION BEHIND ABUTMENTS AND WING WALLS:–

Wing walls and abutments shall be backfilled in horizontal layers not exceeding 15cm in depth. Before placing successive layers, each layer shall be thoroughly compacted by hand operated mechanical tampers. As the back fill is built up the fill infront of wing walls shall be placed simultaneously and mechanically compacted. Spreading of backfill material shall be by hand.

CASTING OF CONCRETE DECK SLABS:–

Each deck slab shall preferable be cast in one continuous, uninterrupted operation. The rate of supply of concrete and working force shall be adequate to prevent cold joints, or partial setting of concrete, prior to placing continuous batches. Before casting is authorized the reinforcing steel shall be correctly placed, spaced, tied and supported. All reinforcing steel shall be inspected by the supervisor prior to casting concrete in the forms. Rigidly fixed screed forms shall be in place for screed of the concrete grade and contour.

The form bottom shall be clean and wetted down. All open cracks and holes shall be sealed. Runways for use in placing concrete shall be supported on the form bottom in such a manner as to prevent contact with the reinforcing steel at all time. The use of aggregate or rock particles as bar supports or separators shall not be permitted.

Cement mortar blocks prepared for these purposes, shall consist of one part cement to two parts sand and shall be cured for a minimum of seven days prior to use. Blocking and separation of the top and bottom reinforcement shall be at a minimum 1m centres each way.

CONSTRUCTION OF ABUTMENTS AND WING WALLS (MASONRY):–

Abutments and wing walls will be founded on foundation fill as per the standard technical specification.

All loose, fractured or otherwise unsuitable material shall be removed prior to starting masonry construction. The masonry shall be adequately keyed on sloping surfaces. Typical details shown in the plan are intended, and should be used, as a guide in adjusting abutment and wing wall construction to the position of sound foundation material at all points.

SPECIFICATIONS FOR MASONRY CONSTRUCTION:–

Technical specifications for the project specifications shall govern all details of masonry construction on the project.

SPECIFICATION FOR STRUCTURAL EXCAVATION:–

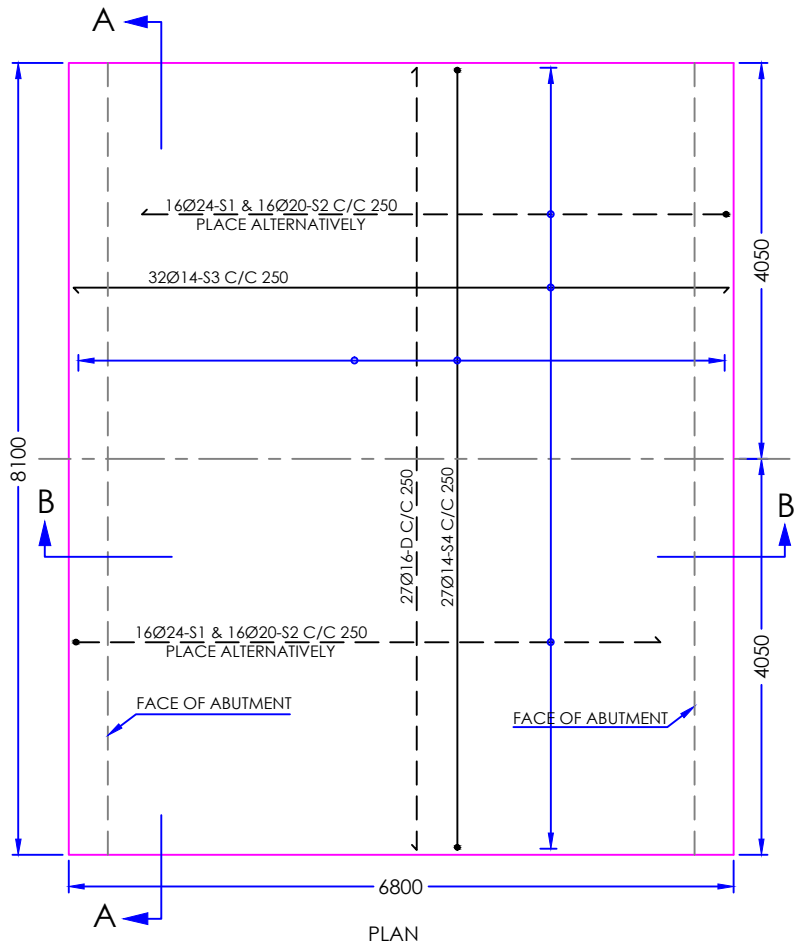
The width of the pay excavation shall be as per technical specifications.

SPECIFICATION FOR POINTING:–

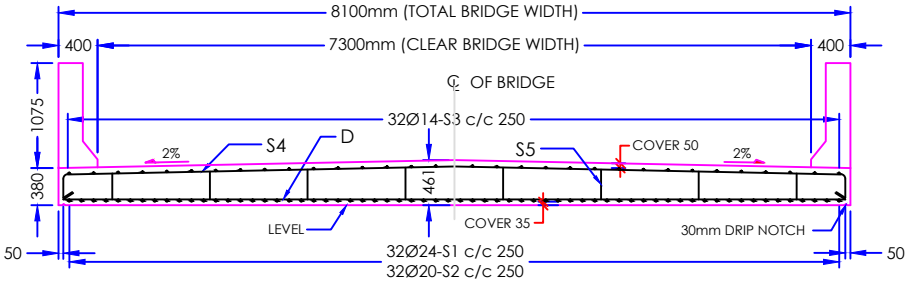
Finishing of all joints shall be according to the prevailing version of ERA's standard specification.

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA ETHIOPIAN ROADS AUTHORITY	REVISION DATE:	DRAWN BY: ADANECH T.	SCALE:	TITLE:	
ERA BRIDGE DESIGN MANUAL 2011 STANDARD DRAWINGS	EDITED BY: STEPHEN KIRSTEN	DESIGNED BY: ASHENAFI L. / SAMUEL G. CHECKED BY: TESHOME W. / Mr. YOSHINORI OBATA APPROVED BY: BEKELE JEBESSA	NTSC DATE: NOVEMBER, 2011	GENERAL NOTE DRAWING No.: B - 01	

NOTE :- GUARD-RAILING, REFER TO GUARDRAIL STANDARD DRAWING (B - 16,17)



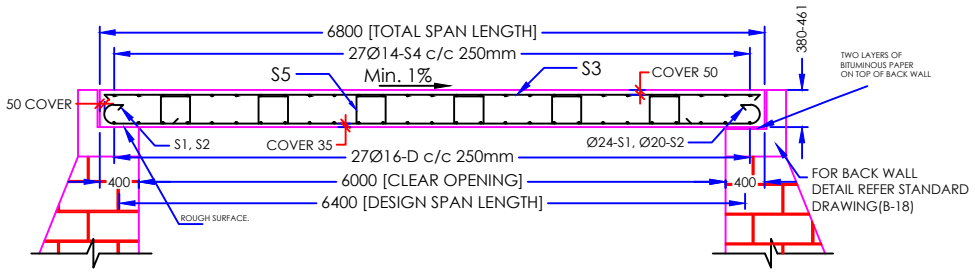
PLAN



TYPICAL CROSS SECTION A-A

REINFORCING BAR SCHEDULE												
BAR	SIZE (mm)	NUMBER	BAR TYPE	DIMENSIONS (mm)					LENGTH (mm)	BAR c/c SPACING (mm)	TOTAL LENGTH (m)	TOTAL WEIGHT (kg)
				A	B	C	D	J				
S1	24	32	*	300	6000	-	-	192	6300	250	201.60	716.10
S2	20	32	*	250	6000	-	-	160	6250	250	200.00	493.40
S3	14	32	Str.	-	-	-	-	-	6700	250	214.40	259.21
S4	14	27	*	-	7900	220	220	-	8340	250	225.18	272.24
S5	12	48	*	-	-	-	-	-	1100	1000	52.80	46.89
D	16	27	Str.	-	-	-	-	-	8000	250	216.00	341.10
												2,128.9

* See details on this sheet.



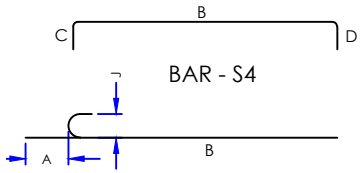
LONGITUDINAL SECTION B-B

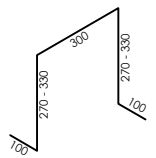
LEGEND:

Top Reinf. (Straight bar)

Bottom Reinf. (Straight bar)

Hook or Bend at end.





BAR - S5
Ø12, Lav. = 1.10 m

CONCRETE ..... 23.20 m^3

REINFORCEMENT STEEL ..... 2,128.9 kg

GENERAL NOTES:

MANUALS USED:- THE PREVAILING VERSIONS OF THE ERA BRIDGE DESIGN MANUAL AND AASHTO LRFD Bridge Design Specification

LOADINGS USED:- HL-93 ACCORDING TO CHAPTER 3 OF THE ABOVE SPECIFICATIONS.

ALL DIMENSIONS ARE IN MILLIMETERS.

MATERIAL PROPERTIES (STRENGTH):

CONCRETE:- THE MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS SHALL BE 24MPa (GRADE C30).

REINFORCEMENT STEEL:- THE MINIMUM YIELD STRENGTH OF DEFORMED BAR SHALL BE 400 MPa FOR BAR DIAMETER GREATER OR EQUAL TO 20mm AND 300 MPa FOR BAR DIAMETER LESSTHAN 20mm.

FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION.

ALL BAR DIMENSIONS ARE MEASURED OUT TO OUT.

OVERLAP:- Ø12 - 400mm, Ø16 - 500mm, Ø24-1000mm

NOTE:- PROVIDE MINIMUM 1% LONGITUDINAL SLOPE FOR DRAINAGE

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
ETHIOPIAN ROADS AUTHORITY

PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
STANDARD DRAWINGS

REVISION
DATE:
EDITED BY: STEPHEN KIRSTEN

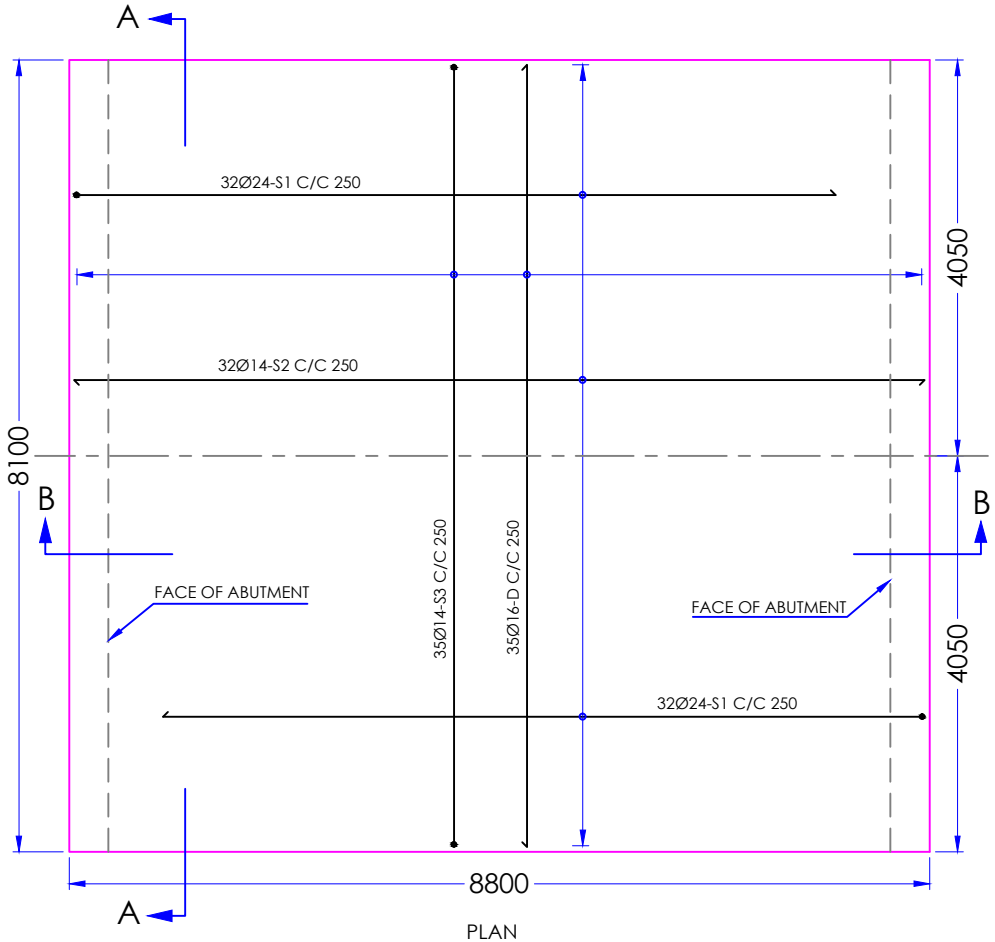
DRAWN BY: ADANECH T.
DESIGNED BY: ASHENAFI L. / SAMUEL G.
CHECKED BY: TESHOME W. / Mr. YOSHINORI OBATA
APPROVED BY: BEKELE JEBESSA

SCALE: NORMAL TO SCALE

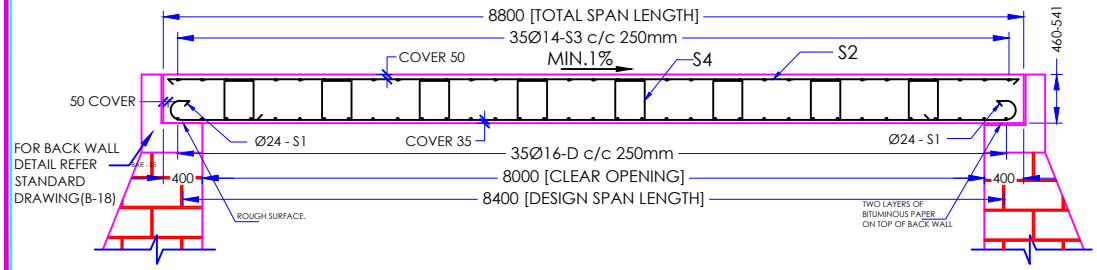
DATE: NOVEMBER, 2011

TITLE: 6.0m SPAN RC SLAB BRIDGE SUPERSTRUCTURE; WIDTH 7.30m.

DRAWING No.: B - 02

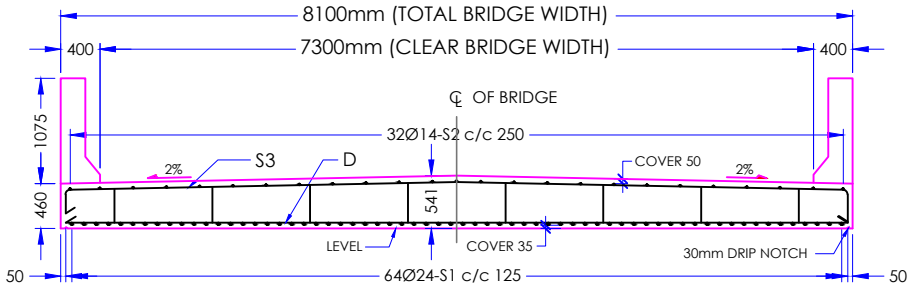


PLAN



LONGITUDINAL SECTION B-B

NOTE :- FOR GUARD-RAILING, REFER TO GUARDRAIL STANDARD DRAWING (B - 16,17)



TYPICAL CROSS SECTION A-A

REINFORCING BAR SCHEDULE

BAR	SIZE (mm)	NUMBER	BAR TYPE	DIMENSIONS (mm)					LENGTH (mm)	BAR c/c SPACING (mm)	TOTAL LENGTH (m)	TOTAL WEIGHT (kg)
				A	B	C	D	J				
S1	24	64	*	300	7800	-	-	192	8100	125	518.40	1841.4
S2	14	32	Str.	-	-	-	-	-	8700	250	278.40	336.6
S3	14	35	*	-	7900	220	220	-	8340	250	291.90	352.9
S4	12	68	Str.	-	-	-	-	-	1250	1000	85.00	75.5
D	16	35	Str.	-	-	-	-	-	8000	250	280.00	442.1
												3,048.5

* See details on this sheet.

LEGEND:

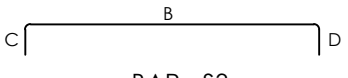
Top Reinf. (Straight bar)

Bottom Reinf. (Straight bar)

Hook or Bend at end.

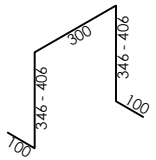
CONCRETE ..... 35.64 m^3

REINFORCEMENT STEEL ..... 3,048.5 kg



BAR - S3

BAR - S1



BAR - S4
Ø12, Lav. = 1.25 m

GENERAL NOTES:

MANUALS USED:- THE PREVAILING VERSIONS OF THE ERA BRIDGE DESIGN MANUAL AND AASHTO LRFD Bridge Design Specification

LOADINGS USED:- HL-93 ACCORDING TO CHAPTER 3 OF THE ABOVE SPECIFICATIONS.

ALL DIMENSIONS ARE IN MILLIMETERS.

MATERIAL PROPERTIES (STRENGTH):

CONCRETE:- THE MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS SHALL BE 24MPa (GRADE C30).

REINFORCEMENT STEEL:- THE MINIMUM YIELD STRENGTH OF DEFORMED BAR SHALL BE 400 MPa FOR BAR DIAMETER GREATER OR EQUAL TO 20mm AND 300 MPa FOR BAR DIAMETER LESSTHAN 20mm.

FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION.

ALL BAR DIMENSIONS ARE MEASURED OUT TO OUT.

OVERLAP:- Ø12 - 400mm, Ø16 - 500mm, Ø24-1000mm

NOTE:- PROVIDE MINIMUM 1% LONGITUDINAL SLOPE FOR DRAINAGE

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
ETHIOPIAN ROADS AUTHORITY

PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
STANDARD DRAWINGS

REVISION
DATE:

EDITED BY: STEPHEN KIRSTEN

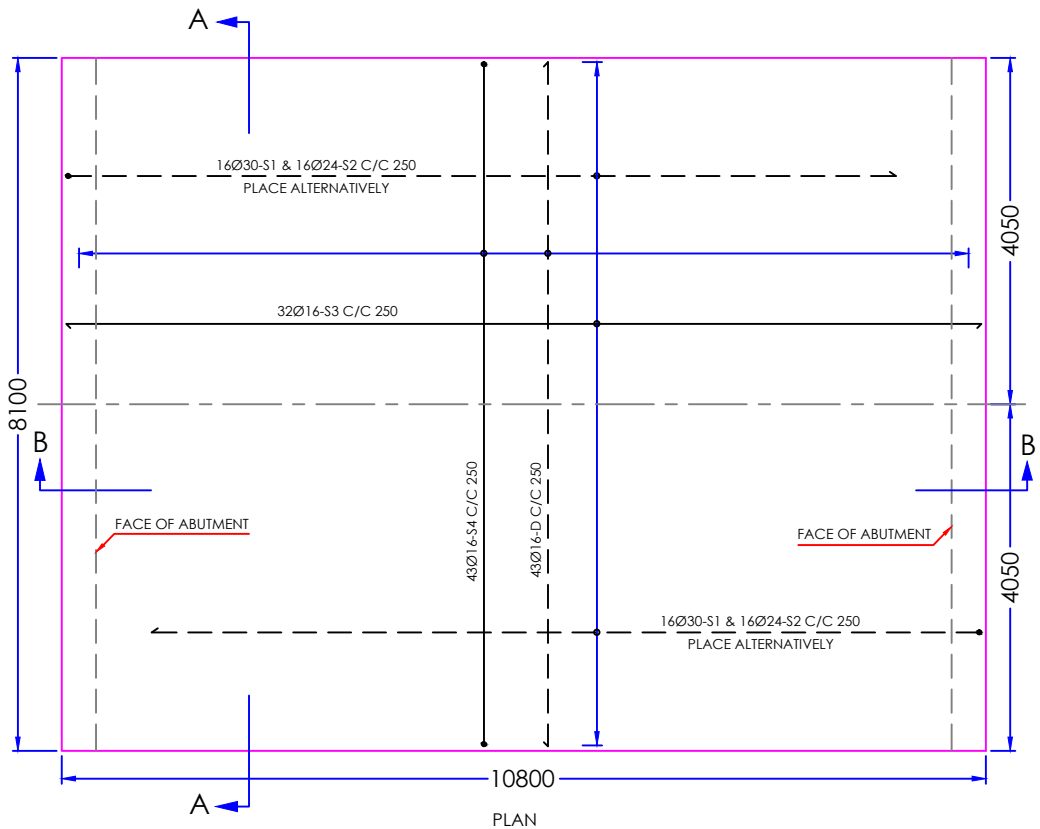
DRAWN BY: ADANECH T.
DESIGNED BY: ASHENAFI L. / SAMUEL G.
CHECKED BY: TESHOME W. / Mr. YOSHINORI OBATA
APPROVED BY: BEKELE JEBESSA

SCALE: NORMAL TO SCALE

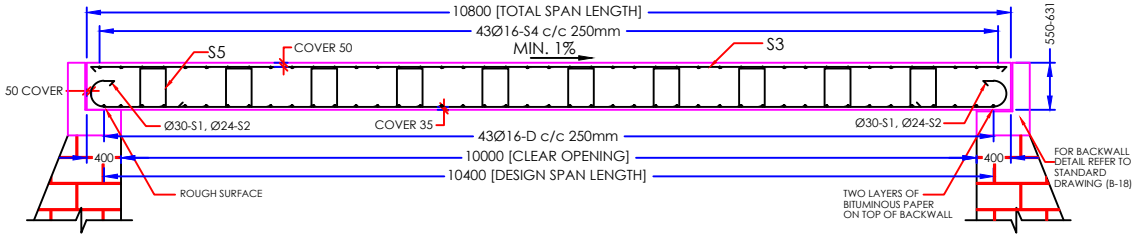
DATE: NOVEMBER, 2011

TITLE: 8.0m SPAN RC SLAB BRIDGE SUPERSTRUCTURE; WIDTH 7.30m.

DRAWING No.: B - 03

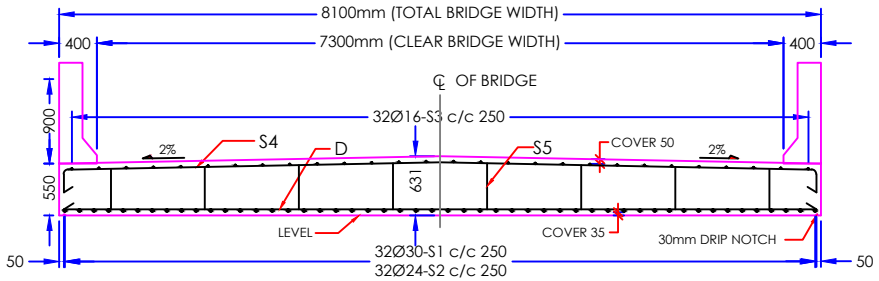


PLAN



LONGITUDINAL SECTION B-B

NOTE :- FOR POST & RAILING, REFER TO GUARDRAIL STANDARD DRAWING (B - 16,17)



TYPICAL CROSS SECTION A-A

REINFORCING BAR SCHEDULE

BAR	SIZE (mm)	NUMBER	BAR TYPE	DIMENSIONS (mm)					LENGTH (mm)	BAR c/c SPACING (mm)	TOTAL LENGTH (m)	TOTAL WEIGHT (kg)
				A	B	C	D	J				
S1	30	32	*	440	9700	-	-	300	10140	250	324.48	1800.86
S2	24	32	*	300	9700	-	-	192	10000	250	320.00	1136.64
S3	16	32	Str.	-	-	-	-	-	10700	250	342.40	540.65
S4	16	43	*	-	7900	260	260	-	8420	250	326.34	515.29
S5	12	80	*	-	-	-	-	-	1420	1000	113.60	100.88
D	16	43	Str.	-	-	-	-	-	8000	250	344.00	543.18
												4,637.50

* See details on this sheet.

LEGEND:

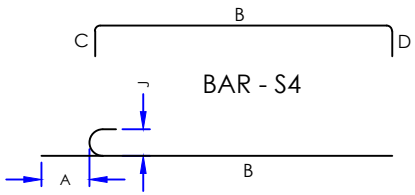
Top Reinf. (Straight bar)

Bottom Reinf. (Straight bar)

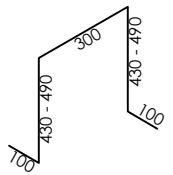
Hook or Bend at end.

CONCRETE ..... 51.67 m^3

REINFORCEMENT STEEL ..... 4,637.50 kg



BAR - S1, S2



BAR - S5
Ø12, Lav. = 1.42 m

GENERAL NOTES:

MANUALS USED:- THE PREVAILING VERSIONS OF THE ERA BRIDGE DESIGN MANUAL AND AASHTO LRFD Bridge Design Specification

LOADINGS USED:- HL-93 ACCORDING TO CHAPTER 3 OF THE ABOVE SPECIFICATIONS.

ALL DIMENSIONS ARE IN MILLIMETERS.

MATERIAL PROPERTIES (STRENGTH):

CONCRETE:- THE MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS SHALL BE 24MPa (GRADE C30).

REINFORCEMENT STEEL:- THE MINIMUM YIELD STRENGTH OF DEFORMED BAR SHALL BE 400 MPa FOR BAR DIAMETER GREATER OR EQUAL TO 20mm AND 300MPa FOR BAR DIAMETER LESSTHAN 20mm.

FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION.

ALL BAR DIMENSIONS ARE MEASURED OUT TO OUT.

OVERLAP:- Ø12 - 400mm, Ø16 - 500mm, Ø24-1000mm,Ø30 -1600mm

NOTE:- PROVIDE MINIMUM 1% LONGITUDINAL SLOPE FOR DRAINAGE

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
ETHIOPIAN ROADS AUTHORITY

THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL STANDARD DRAWINGS

REVISION
DATE:
EDITED BY: STEPHEN KIRSTEN

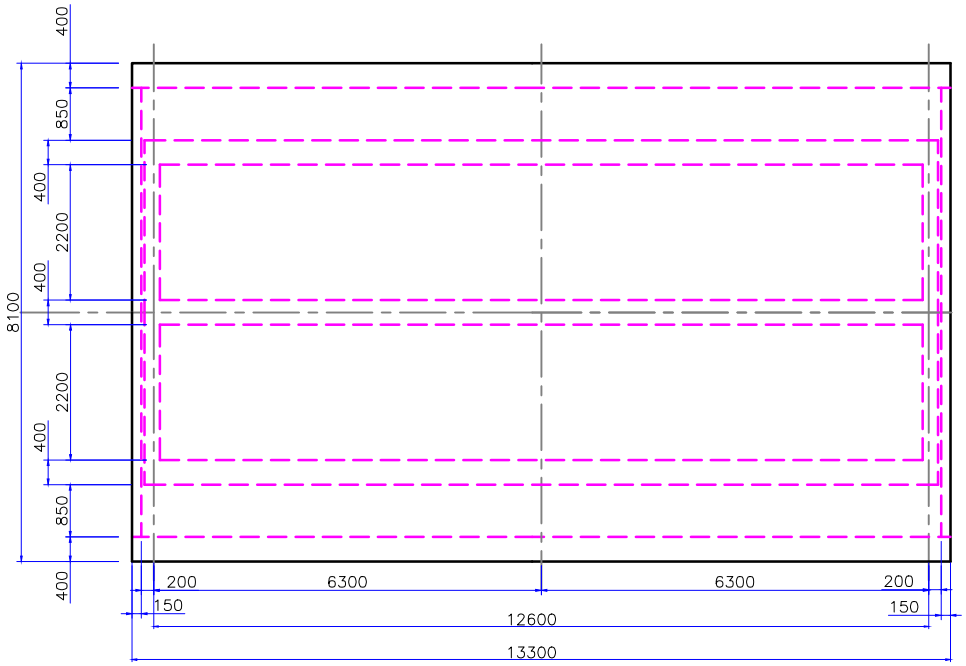
DRAWN BY: ADANECH T.
DESIGNED BY: ASHENAFI L. / SAMUEL G.
CHECKED BY: TESHOME W. / Mr. YOSHINORI OBATA
APPROVED BY: BEKELE JEBESSA

SCALE: NORMAL TO SCALE

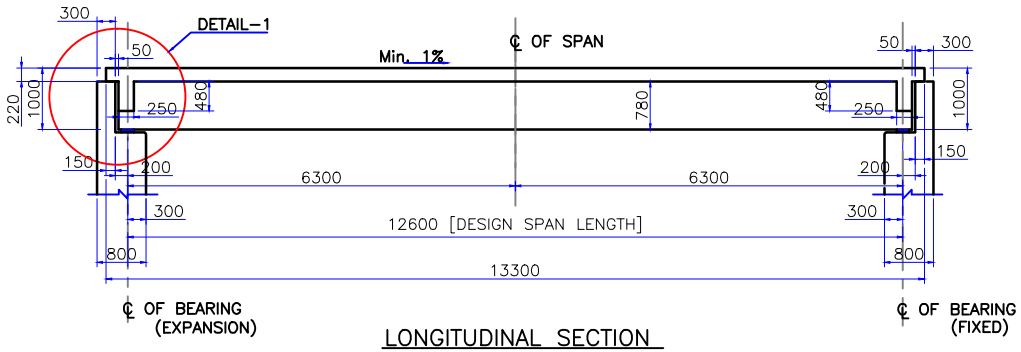
DATE: NOVEMBER, 2011

TITLE: 10.0m SPAN RC SLAB BRIDGE SUPERSTRUCTURE; WIDTH 7.30m.

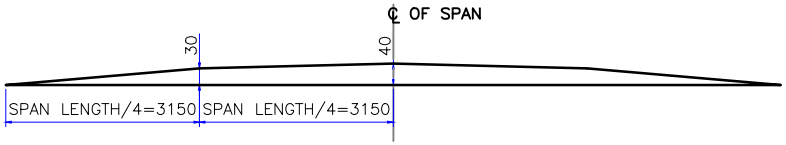
DRAWING No.: B - 04



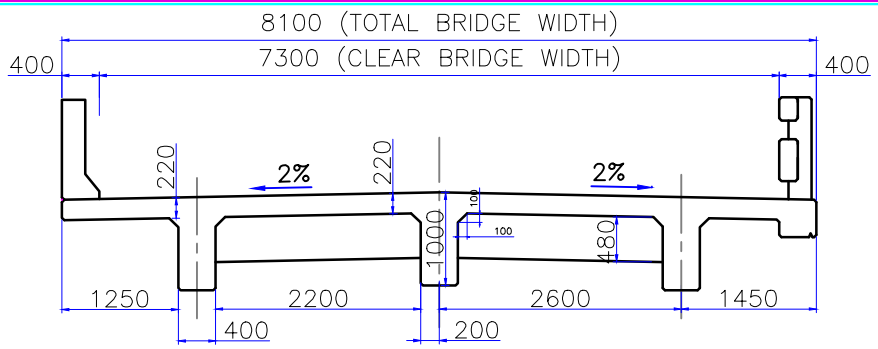
PLAN



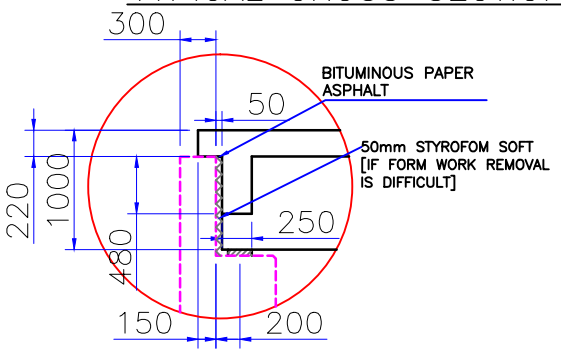
LONGITUDINAL SECTION



CAMBER TO BE PROVIDED BENEATH GIRDERS



TYPICAL CROSS SECTION



DETAIL–1

GENERAL NOTES:

MANUALS USED–THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL

LOADINGS USED : – HL–93 ACCORDING

ALL DIMENSIONS ARE IN MILLIMETERS.

MATERIAL PROPERTIES (STRENGTH)

CONCRETE :– THE MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS SHALL BE 24MPa (C–30).

REINFORCEMENT STEEL:– THE MINIMUM YIELD STRENGTH OF DEFORMED BAR SHALL BE 400 MPA(FOR DIAM>=20MM) AND 300 FOR BARS(DIAM<20MM) IN ACCORDANCE WITH ERA BRIDGE DESIGN MANUAL–2011

ALL BAR DIMENSIONS ARE MEASURED OUT TO OUT

OVERLAP ø12, –400mm. ø16, –500mm. ø32, –1800mm.

FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION

NOTE:– PROVIDE MINIMUM 1% LONGITUDINAL SLOPE FOR DRAINAGE. ON CROSS SECTION DRAWING DIFFERENT GUARDRAIL IS ONLY TO SHOW THE TYPES BUT DURING CONSTRUCTION IT SHALL BE THE SAME TYPE AS PER THE CONSULTANT PREFERENCE.

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
ETHIOPIAN ROADS AUTHORITY

PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
STANDARD DRAWINGS

REVISION
DATE:

EDITED BY: STEPHEN KIRSTEN

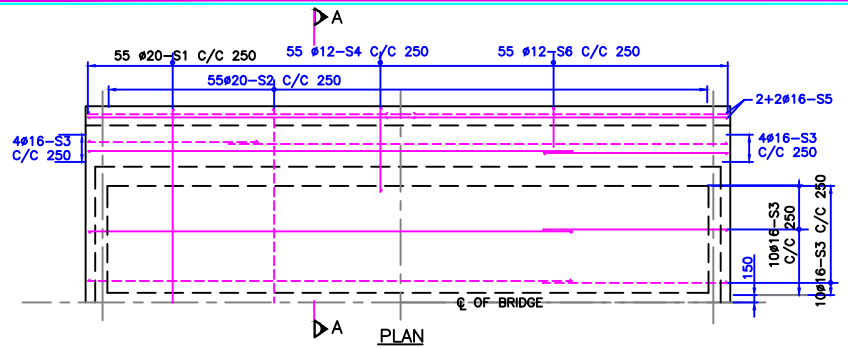
DRAWN BY: ADANECH T.
DESIGNED BY: ASHENAFI L. / SAMUEL G.
CHECKED BY: TESHOME W. / Mr. YOSHINORI OBATA
APPROVED BY: BEKELE JEBESSA

SCALE: NORMAL TO SCALE

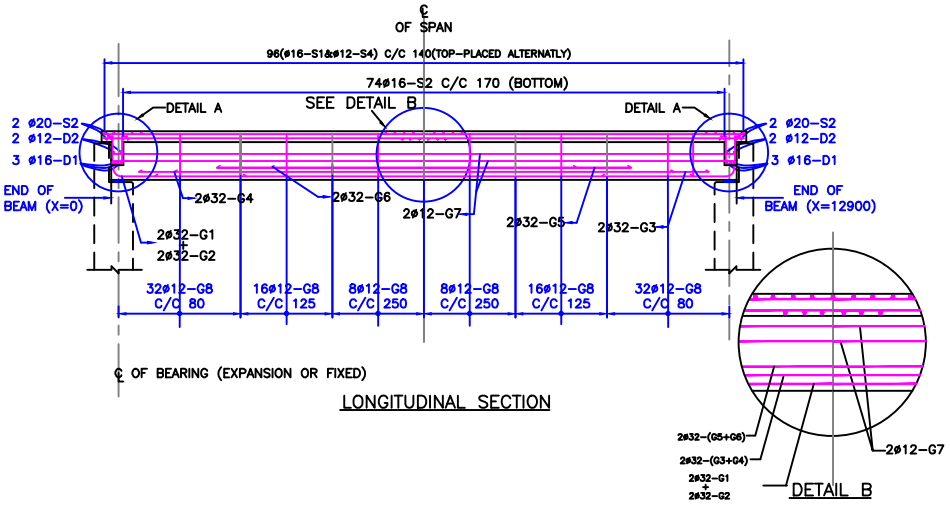
DATE: NOVEMBER, 2011

TITLE: 12m SPAN RC DECK GIRDER SUPERSTRUCTURE; WIDTH 7.30m.
SHEET 1/2

DRAWING No.: B - 05

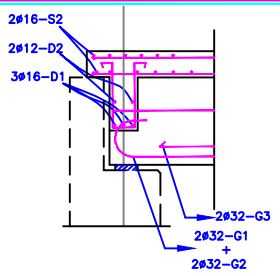


PLAN

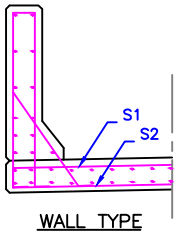


LONGITUDINAL SECTION

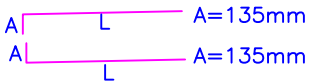
DETAIL B

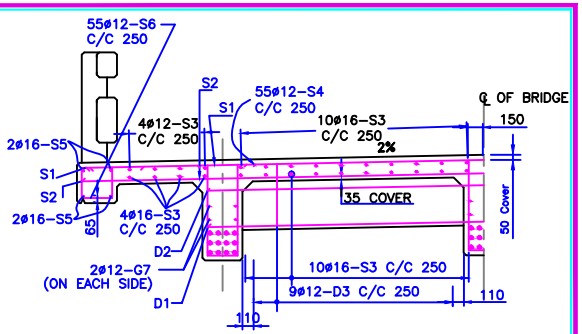


DETAIL A



WALL TYPE GUARDRAIL





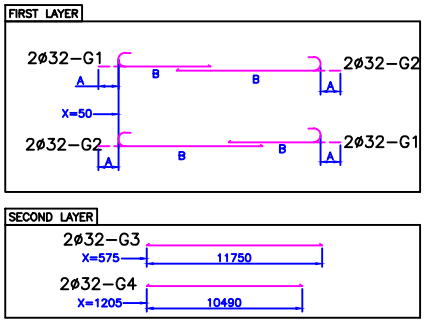
TYPICAL CROSS SECTION

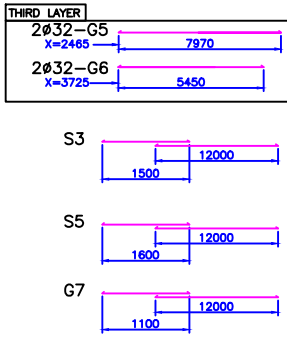
REINFORCING BAR SCHEDULE

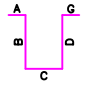
BAR MARK	SIZE (mm)	NUMBER	BAR TYPE	DIMENSIONS (mm) A	B	C	D	E	F	G	J	BAR LENGTH (mm)	TOTAL LENGTH (m)	TOTAL WEIGHT (Kg)
D1	16	6	Str.	–	–	–	–	–	–	–	–	5530	33.18	52
D2	12	4	Str.	–	–	–	–	–	–	–	–	5530	22.12	20
D3	12	36	*	100	550	200	550	–	–	100	–	1500	54.00	48
G1	32	12	*	470	3150	–	–	–	–	–	320	3620	43.44	275
G2	32	12	*	470	11530	–	–	–	–	–	320	12000	144.00	909
G3	32	6	Str.	–	–	–	–	–	–	–	–	12000	70.50	445
G4	32	6	Str.	–	–	–	–	–	–	–	–	10500	62.94	397
G5	32	6	Str.	–	–	–	–	–	–	–	–	8000	47.82	302
G6	32	6	Str.	–	–	–	–	–	–	–	–	5450	32.70	206
G7	12	12	Str.	–	–	–	–	–	–	–	–	13100	157.20	140
G8	12	336	*	100	910	300	910	–	–	100	–	2320	779.52	693
S1	20	55	Str.	–	–	–	–	–	–	–	–	8070	443.85	1095
S2	20	55	Str.	–	–	–	–	–	–	–	–	8070	443.85	1095
S3	16	56	Str.	–	–	–	–	–	–	–	–	13500	756.00	1194
S4	12	110	Str.	–	–	–	–	–	–	–	–	1750	192.50	171
S5	16	8	Str.	–	–	–	–	–	–	–	–	13600	108.80	172
S6	12	110	*	–	750	280	350	280	200	–	–	1860	204.60	182

* See details on this sheet Str.---implies straight bars.

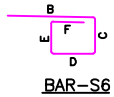
BAR SCHEDULE



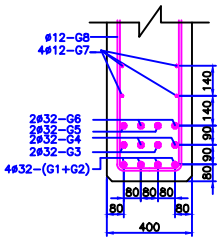




BAR–G8&D3



BAR–S6



GIRDER REINFORCEMENT DETAIL

NOTE:
THE SPLICING OF BAR G'S SHALL BE VERTICALLY AS SHOWN BELOW
SPLICED BAR

QUANTITIES
REINFORCEMENT: 7396Kg.
CONCRETE: 44.00m³

GENERAL NOTES:
MANUALS USED–THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
LOADINGS USED :– HL–93 ACCORDING
TO CHAPTER 3 OF THE ABOVE SPECIFICATIONS.
ALL DIMENSIONS ARE IN MILLIMETERS.

REINFORCEMENT SUMMARY				
BAR SIZE	12	16	20	32
TOT. Wt.	1254	1418	2190	2534
GROSS TOT. Wt.---7396kg				

MATERIAL (STRENGTH) PROPERTIES
CONCRETE :– THE MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS SHALL BE 24MPa (C–30).
REINFORCEMENT STEEL:– THE MINIMUM YIELD STRENGTH OF DEFORMED BAR SHALL BE 400 MPA FOR DIAM. >=20mm AND 300 MPA FOR DIA <20mm.
FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION
ALL BAR DIMENSIONS ARE OUT TO OUT
OVERLAP ø12, –400mm. ø16, –500mm. ø20, –800mm. ø24, –1000mm. ø30, –1600mm. ø32, –1800mm.

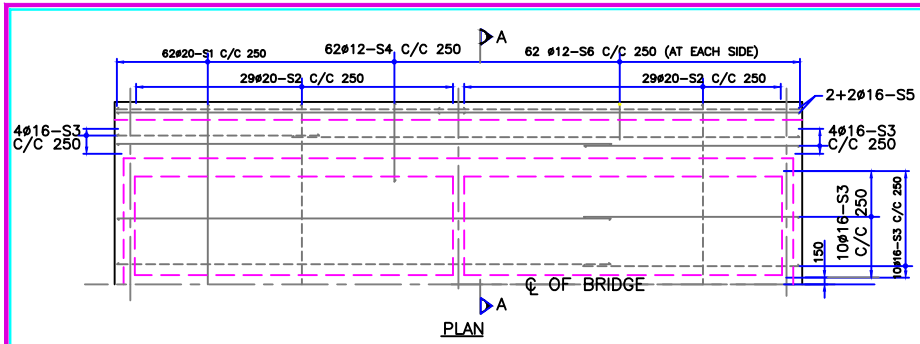
THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
ETHIOPIAN ROADS AUTHORITY
PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
STANDARD DRAWINGS

REVISION
DATE:
EDITED BY: STEPHEN KIRSTEN

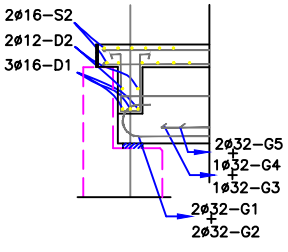
DRAWN BY: ADANECH T.
DESIGNED BY: ASHENAFI L. / SAMUEL G.
CHECKED BY: TESHOME W. / Mr. YOSHINORI OBATA
APPROVED BY: BEKELE JEBESSA

SCALE: NORMAL TO SCALE
DATE: NOVEMBER, 2011

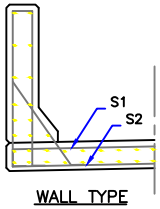
TITLE: 12m SPAN RC DECK GIRDER SUPERSTRUCTURE; WIDTH 7.30m.
SHEET 2/2
DRAWING No.: B - 06



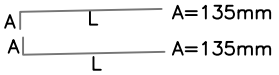
PLAN

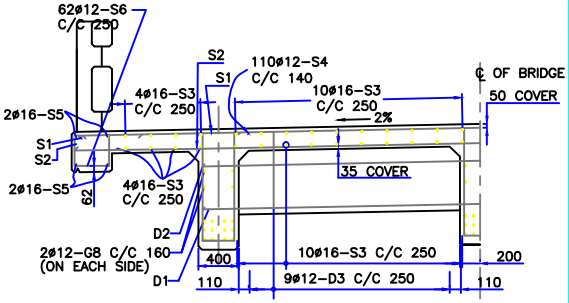


DETAIL A

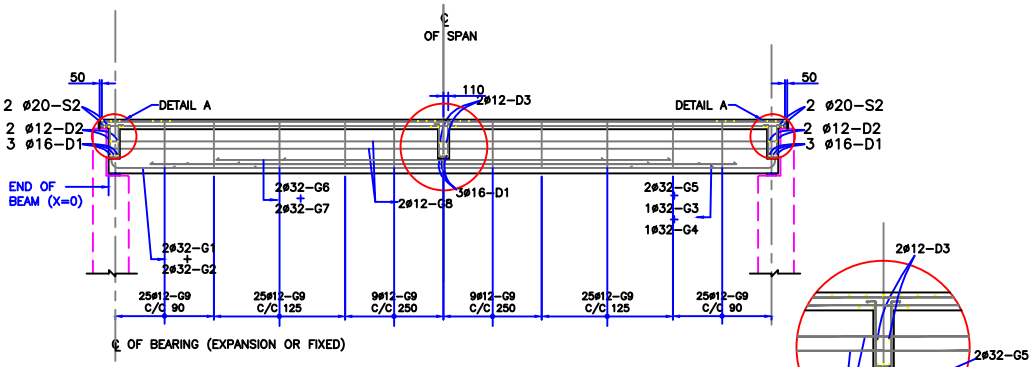


WALL TYPE GUARDRAIL

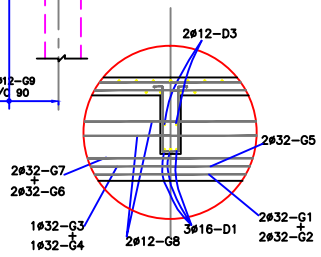




TYPICAL CROSS SECTION A–A



LONGITUDINAL SECTION



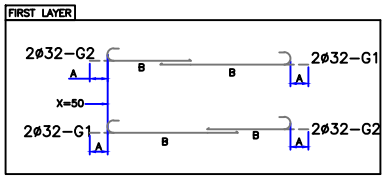
DETAIL B

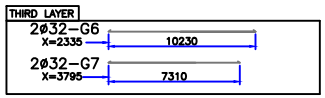
REINFORCING BAR SCHEDULE

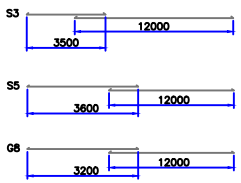
BAR MARK	SIZE (mm)	NUMBER	BAR TYPE	DIMENSIONS (mm) A	B	C	D	E	F	G	J	BAR LENGTH (mm)	TOTAL LENGTH (m)	TOTAL WEIGHT (Kg)
D1	16	9	Str.	–	–	–	–	–	–	–	–	5530	49.77	79
D2	12	6	Str.	–	–	–	–	–	–	–	–	5530	33.18	29
D3	12	54	*	100	700	200	700	–	–	100	–	1800	97.20	86
G1	32	12	*	470	11530	–	–	–	–	–	320	12000	144.00	909
G2	32	12	*	470	5150	–	–	–	–	–	320	5620	67.44	426
G3	32	6	Str.	–	3000	–	–	–	–	–	–	3000	18.18	115
G4	32	6	Str.	–	12000	–	–	–	–	–	–	12000	72.00	455
G5	32	6	Str.	–	–	–	–	–	–	–	–	11690	70.14	443
G6	32	6	Str.	–	–	–	–	–	–	–	–	10230	61.38	388
G7	32	6	Str.	–	–	–	–	–	–	–	–	7310	43.86	277
G8	12	12	Str.	–	–	–	–	–	–	–	–	15200	182.40	162
G9	12	354	*	100	1100	300	1100	–	–	100	–	2700	955.80	849
S1	20	62	Str.	–	–	–	–	–	–	–	–	8070	500.4	1235
S2	20	58	Str.	–	–	–	–	–	–	–	–	8070	468.1	1155
S3	16	56	Str.	–	–	–	–	–	–	–	–	15500	868.0	1371
S4	12	124	Str.	–	–	–	–	–	–	–	–	1750	217.0	193
S5	16	8	Str.	–	–	–	–	–	–	–	–	15600	124.80	197
S6	12	124	*	–	750	280	350	280	200	–	–	1860	230.7	205

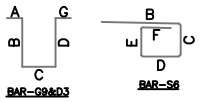
* See details on this sheet Str.---implies straight bars.

BAR SCHEDULE

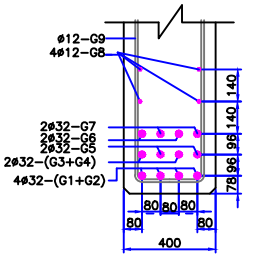








GIRDER REINFORCEMENT DETAIL



NOTE: THE SPLICING OF BAR G'S SHALL BE VERTICALLY AS SHOWN BELOW
SPLICED BAR

QUANTITIES
REINFORCEMENT: 8574Kg.
CONCRETE: 54.00m³

GENERAL NOTES:
MANUALS USED–THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
LOADINGS USED :– HL–93 ACCORDING TO CHAPTER 3 OF THE ABOVE SPECIFICATIONS.
ALL DIMENSIONS ARE IN MILLIMETERS.

REINFORCEMENT SUMMARY				
BAR SIZE	12	16	20	32
TOT. Wt.	1524	1647	2390	3013
GROSS TOT. Wt.---8574kg				

MATERIAL (STRENGTH) PROPERTIES
CONCRETE :– THE MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS SHALL BE 24MPa (C–30).
REINFORCEMENT STEEL:– THE MINIMUM YIELD STRENGTH OF DEFORMED BAR SHALL BE 400 MPA FOR DIAM. >=20mm AND 300 MPA FOR DIA <20mm.
FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION
ALL BAR DIMENSIONS ARE OUT TO OUT
OVERLAP ø12, –400mm. ø16, –500mm. ø20, –800mm. ø24, –1000mm. ø30, –1600mm. ø32, –1800mm.

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
ETHIOPIAN ROADS AUTHORITY

PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
STANDARD DRAWINGS

REVISION
DATE:

EDITED BY: STEPHEN KIRSTEN

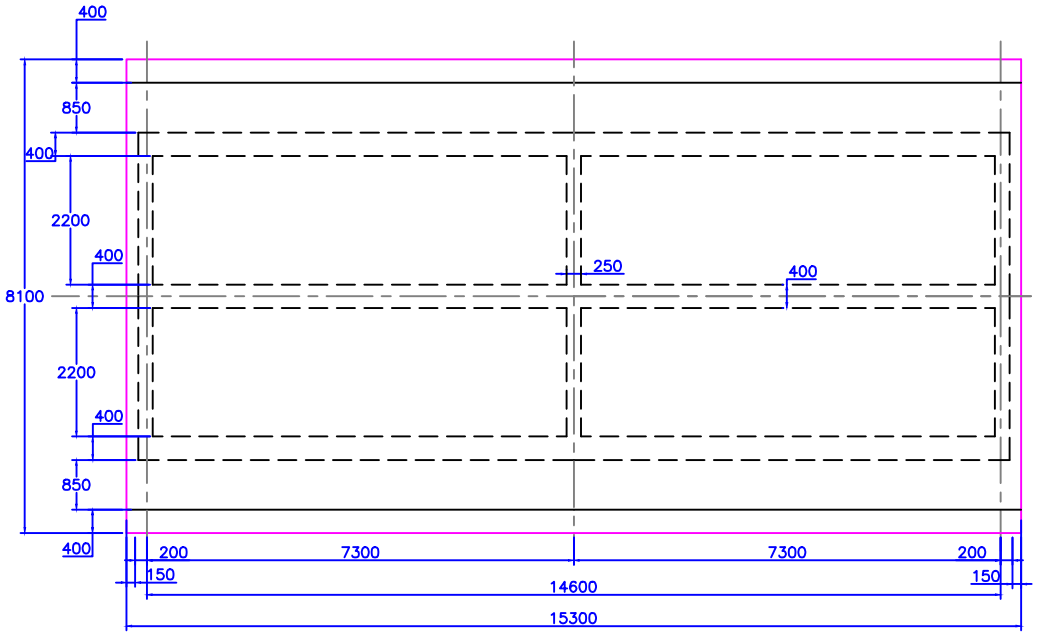
DRAWN BY: ADANECH T.
DESIGNED BY: ASHENAFI L. / SAMUEL G.
CHECKED BY: TESHOME W. / Mr. YOSHINORI OBATA
APPROVED BY: BEKELE JEBESSA

SCALE: NORMAL TO SCALE

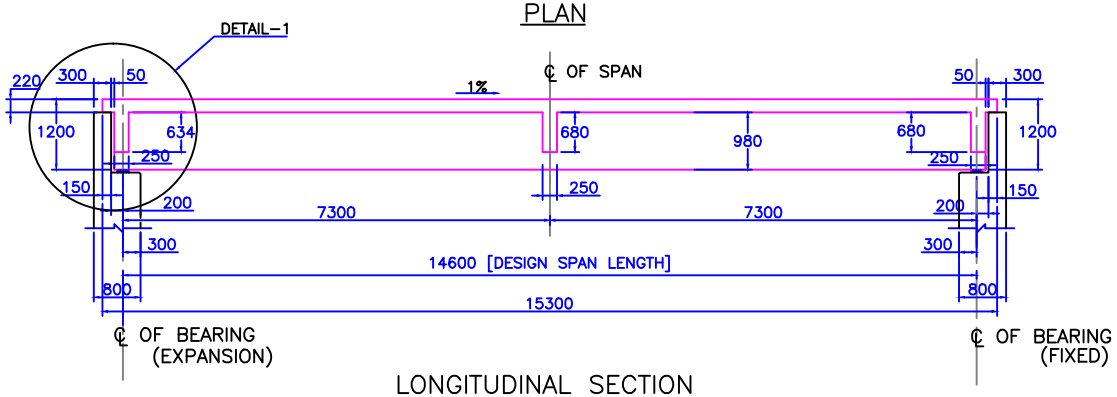
DATE: NOVEMBER, 2011

TITLE: 14m SPAN RC DECK GIRDER SUPERSTRUCTURE; WIDTH 7.30m.
SHEET 2/2

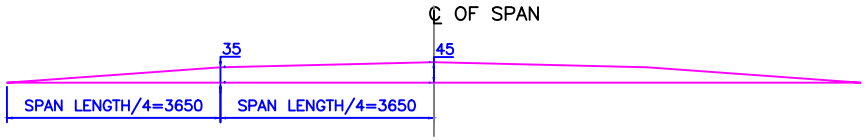
DRAWING No.: B - 07



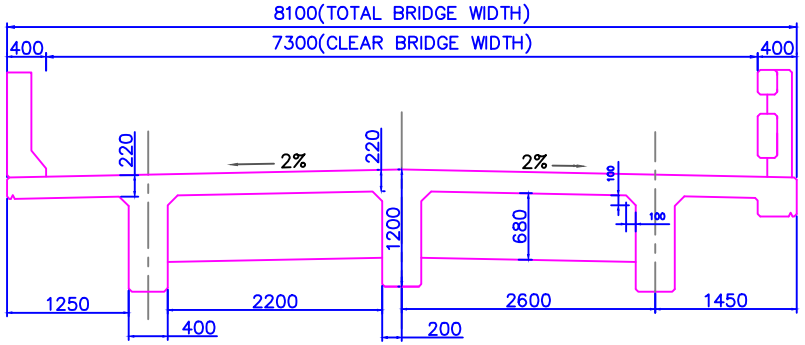
PLAN



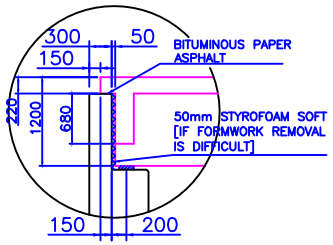
LONGITUDINAL SECTION



CAMBER TO BE PROVIDED BENEATH GIRDERS



TYPICAL CROSS SECTION



DETAIL–1

GENERAL NOTES:

MANUALS USED–THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL

LOADINGS USED : – HL–93 ACCORDING

ALL DIMENSIONS ARE IN MILLIMETERS.

MATERIAL PROPERTIES (STRENGTH)

CONCRETE :– THE MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS SHALL BE 24MPa (C–30).

REINFORCEMENT STEEL:– THE MINIMUM YIELD STRENGTH OF DEFORMED BAR SHALL BE 400 MPA(FOR DIAM>=20MM) AND 300 FOR BARS(DIAM<20MM) IN ACCORDANCE WITH ERA BRIDGE DESIGN MANUAL–2011

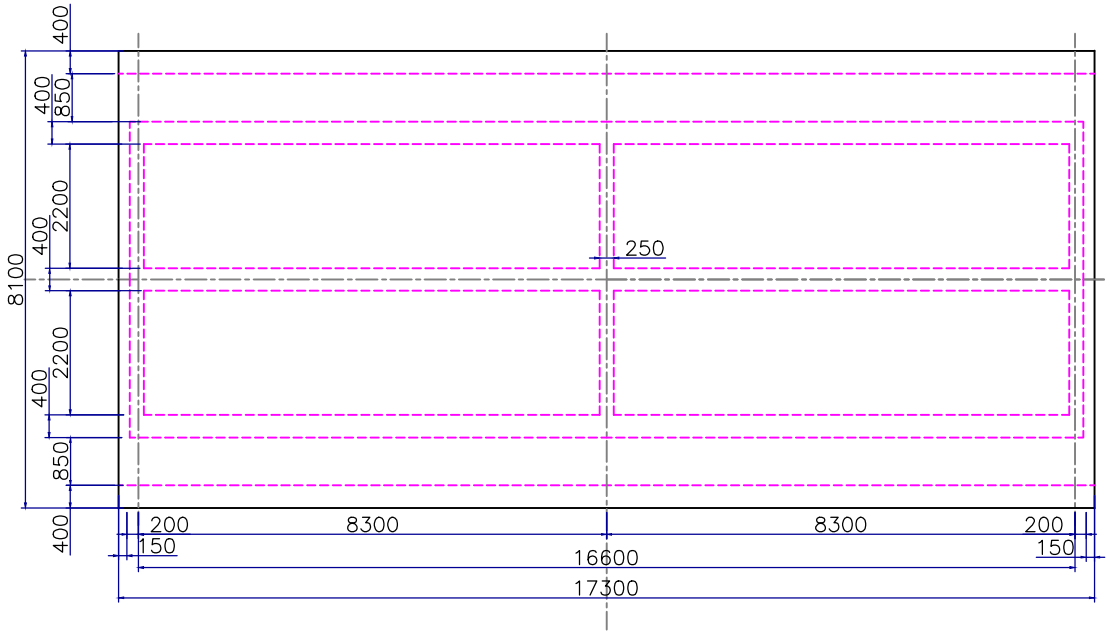
ALL BAR DIMENSIONS ARE MEASURED OUT TO OUT

OVERLAP ø12, –400mm. ø16, –500mm. ø32, –1800mm.

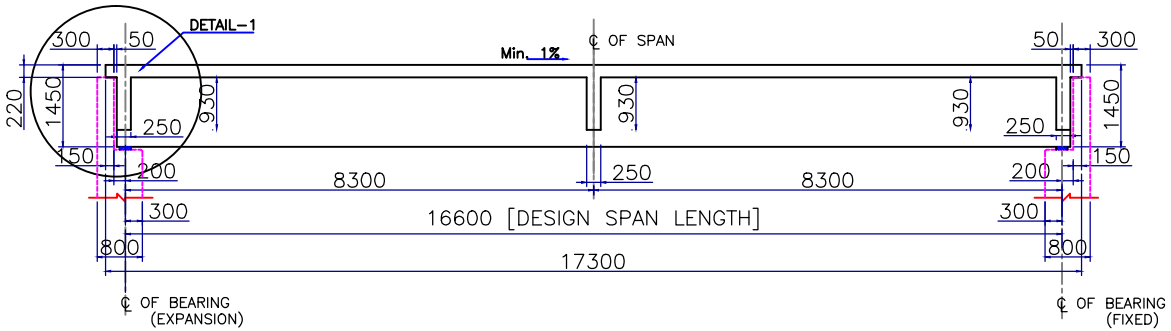
FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION

NOTE:– PROVIDE MINIMUM 1% LONGITUDINAL SLOPE FOR DRAINAGE ON CROSS SECTION DRAWING DIFFERENT GUARDRAIL IS ONLY TO SHOW THE TYPES BUT DURING CONSTRUCTION IT SHALL BE THE SAME TYPE AS PER THE CONSULTANT PREFERENCE.

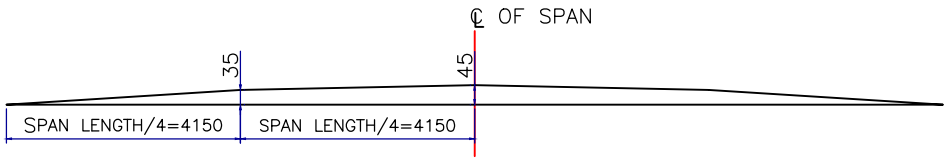
THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA ETHIOPIAN ROADS AUTHORITY	REVISION DATE:	DRAWN BY: ADANECH T. DESIGNED BY: ASHENAFI L. / SAMUEL G. CHECKED BY: TESHOME W. / Mr. YOSHINORI OBATA APPROVED BY: BEKELE JEBESSA	SCALE: NORMAL TO SCALE DATE: NOVEMBER, 2011	TITLE: 14m SPAN RC DECK GIRDER SUPERSTRUCTURE; WIDTH 7.30m. SHEET 1/2 DRAWING No.: B - 08
PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL STANDARD DRAWINGS	EDITED BY: STEPHEN KIRSTEN			



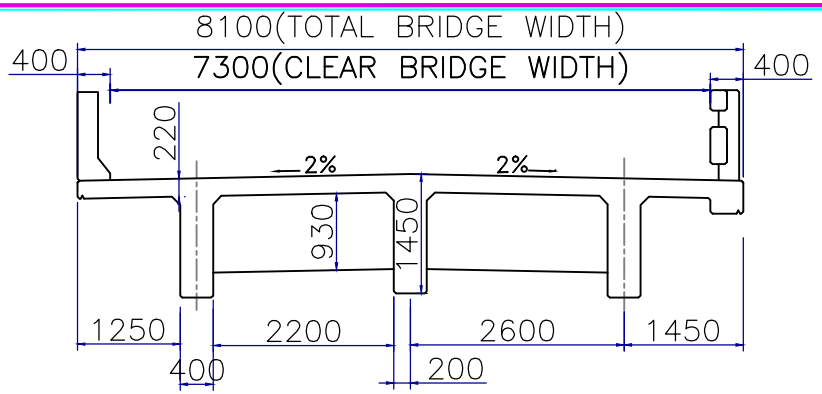
PLAN



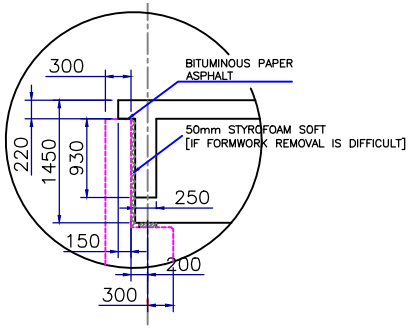
LONGITUDINAL SECTION



CAMBER TO BE PROVIDED BENEATH GIRDERS



TYPICAL CROSS SECTION



DETAIL–1

GENERAL NOTES:

MANUALS USED–THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL

LOADINGS USED : – HL–93 ACCORDING

ALL DIMENSIONS ARE IN MILLIMETERS.

MATERIAL PROPERTIES (STRENGTH)

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ALL BAR DIMENSIONS ARE MEASURED OUT TO OUT

OVERLAP ø12, –400mm. ø16, –500mm. ø32, –1800mm.

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NOTE:– PROVIDE MINIMUM 1% LONGITUDINAL SLOPE FOR DRAINAGE

ON CROSS SECTION DRAWING DIFFERENT GUARDRAIL IS ONLY TO SHOW THE TYPES BUT DURING CONSTRUCTION IT SHALL BE THE SAME TYPE AS PER THE CONSULTANT PREFERENCE.

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
ETHIOPIAN ROADS AUTHORITY

PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
STANDARD DRAWINGS

REVISION
DATE:

EDITED BY: STEPHEN KIRSTEN

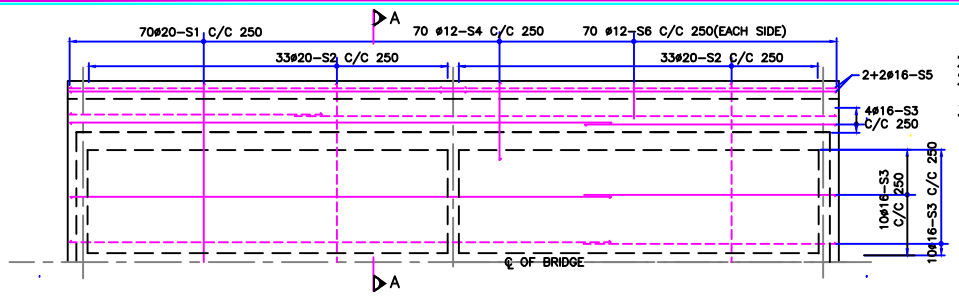
DRAWN BY: ADANECH T.
DESIGNED BY: ASHENAFI L. / SAMUEL G.
CHECKED BY: TESHOME W. / Mr. YOSHINORI OBATA
APPROVED BY: BEKELE JEBESSA

SCALE:
NORMAL TO SCALE

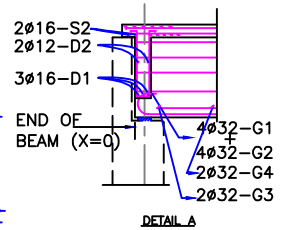
DATE: NOVEMBER, 2011

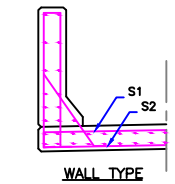
TITLE: 16m SPAN RC DECK GIRDER SUPERSTRUCTURE; WIDTH 7.30m.
SHEET 1/2

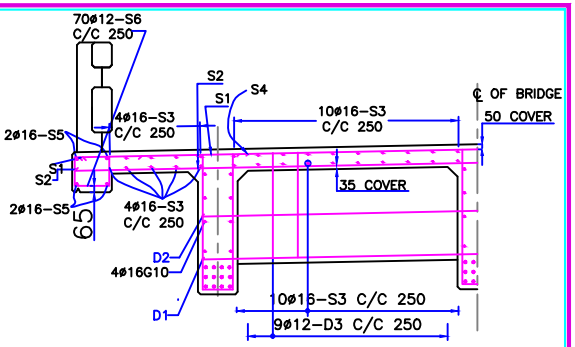
DRAWING No.: B - 09



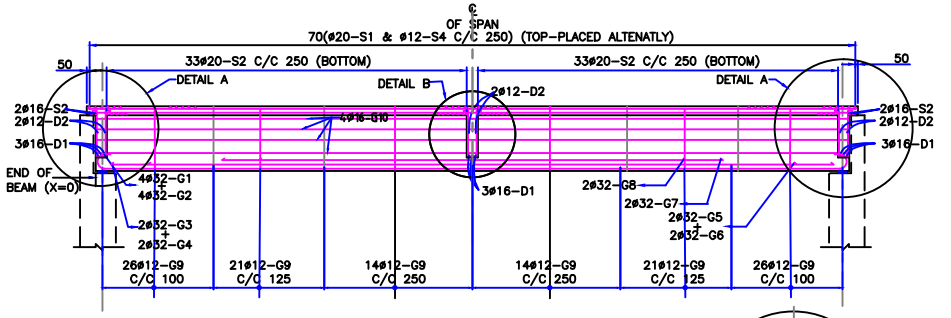
PLAN



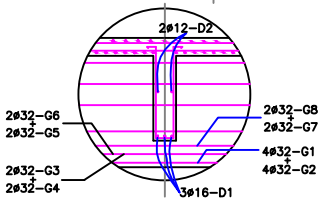




TYPICAL CROSS SECTION A–A



LONGITUDINAL SECTION



DETAIL B

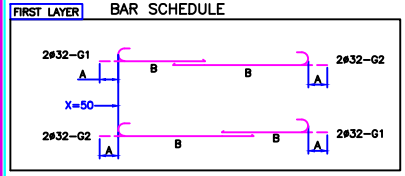
REINFORCING BAR SCHEDULE

BAR	SIZE (mm)	NUMBER	BAR TYPE	DIMENSIONS (mm)								BAR LENGTH (mm)	TOTAL LENGTH (m)	TOTAL WEIGHT (Kg)
				A	B	C	D	E	F	G	J			
D1	16	9	Str.	–	–	–	–	–	–	–	–	5516	49.64	77.67
D2	12	6	Str.	–	–	–	–	–	–	–	–	5516	33.09	29.12
D3	12	54	*	100	1050	200	1050	–	–	100	–	2300	124.20	109.29
G1	32	12	*	470	6250	–	–	–	–	–	320	6720	80.64	504.62
G2	32	12	*	470	11530	–	–	–	–	–	320	12000	144	901.12
G3	32	6	Str.	–	–	–	–	–	–	–	–	6250	37.5	234.67
G4	32	6	Str.	–	–	–	–	–	–	–	–	12000	72	450.56
G5	32	6	Str.	–	–	–	–	–	–	–	–	5370	32.22	201.62
G6	32	6	Str.	–	–	–	–	–	–	–	–	12000	72	450.56
G7	32	6	Str.	–	–	–	–	–	–	–	–	11230	67.38	421.65
G8	32	6	Str.	–	–	–	–	–	–	–	–	9570	57.42	359.32
G9	12	366	*	100	1350	300	1350	–	–	100	–	3100	1135	1008
G10	16	12	Str.	–	–	–	–	–	–	–	–	17244	206.93	323.73
S1	20	70	Str.	–	–	–	–	–	–	–	–	8070	564.9	1394
S2	20	66	Str.	–	–	–	–	–	–	–	–	8070	532.6	1314
S3	16	56	Str.	–	–	–	–	–	–	–	–	17200	963.2	1521
S4	12	140	Str.	–	–	–	–	–	–	–	–	1750	245	218
S5	16	8	Str.	–	–	–	–	–	–	–	–	17200	137.6	218
S6	12	140	*	–	750	280	350	280	200	–	–	1860	260.4	232

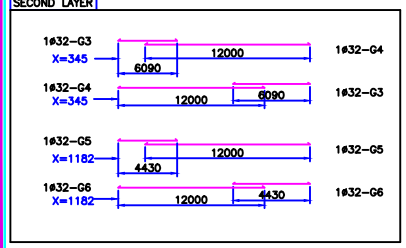
* See details on this sheet Str.–––implies straight bars.

BAR SCHEDULE

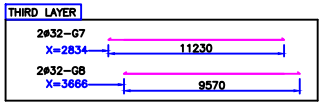
FIRST LAYER

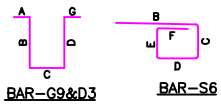


SECOND LAYER

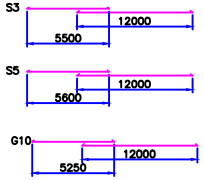


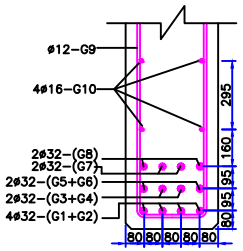
THIRD LAYER





BAR–G9&D3 BAR–S6





GIRDER REINFORCEMENT DETAIL

NOTE: THE SPLICING OF BAR G'S SHALL BE VERTICALLY AS SHOWN BELOW

SPLICED BAR

QUANTITIES
REINFORCEMENT: 9972.00Kg.
CONCRETE: 65.00m³

GENERAL NOTES:
MANUALS USED–THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
LOADINGS USED :– HL–93 ACCORDING
TO CHAPTER 3 OF THE ABOVE SPECIFICATIONS.
ALL DIMENSIONS ARE IN MILLIMETERS.

REINFORCEMENT SUMMARY				
BAR SIZE	12	16	20	32
TOT. WT.	1596	2141	2708	3527
GROSS TOT.Wt.–9972.00Kg				

MATERIAL (STRENGTH) PROPERTIES
CONCRETE :– THE MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS SHALL BE 24MPa (C–30).
REINFORCEMENT STEEL:– THE MINIMUM YIELD STRENGTH OF DEFORMED BAR SHALL BE 400 MPA FOR DIAM. >=20mm AND 300 MPA FOR DIA <20mm.
FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION
ALL BAR DIMENSIONS ARE OUT TO OUT
OVERLAP ø12, –400mm. ø16, –500mmø20, –800mm.
ø24, –1000mm. ø30, –1600mmø32, –1800mm.

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
ETHIOPIAN ROADS AUTHORITY

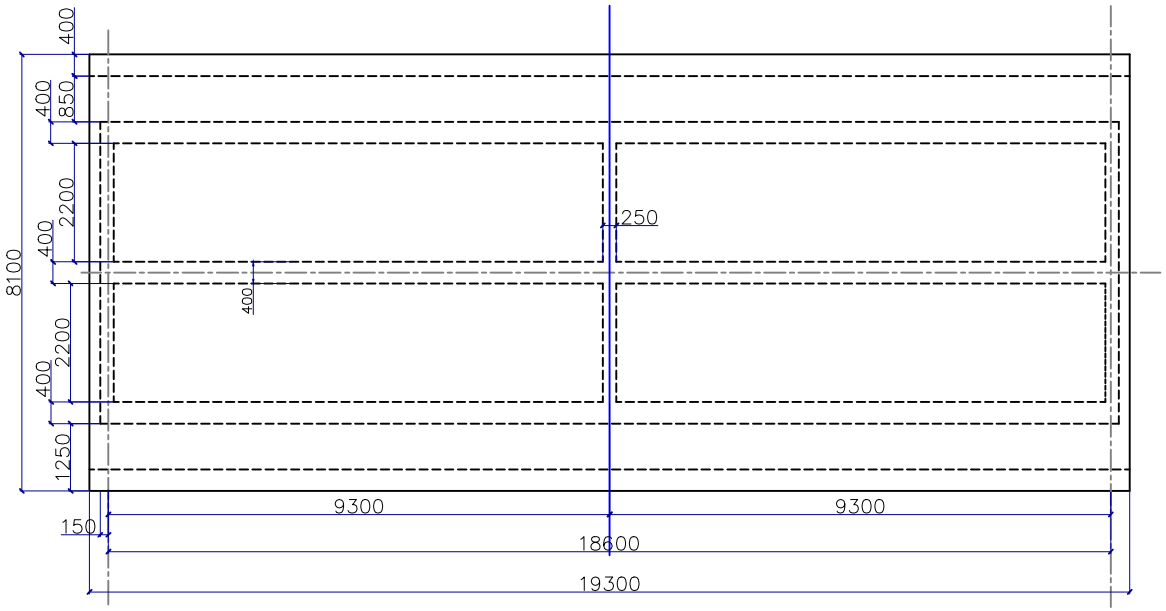
PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
STANDARD DRAWINGS

REVISION
DATE:
EDITED BY: STEPHEN KIRSTEN

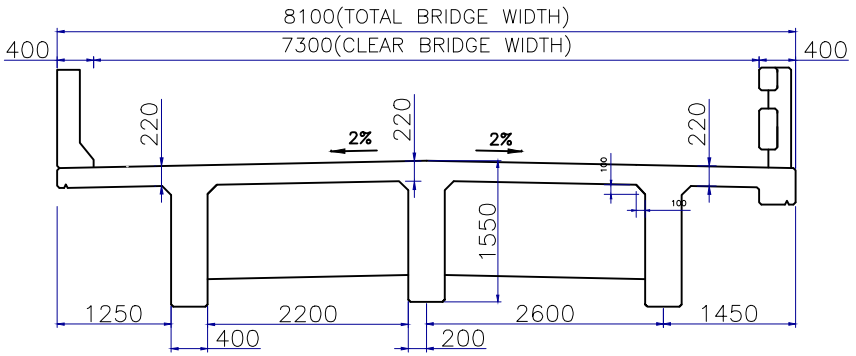
DRAWN BY: ADANECH T.
DESIGNED BY: ASHENAFI L. / SAMUEL G.
CHECKED BY: TESHOME W. / Mr. YOSHINORI OBATA
APPROVED BY: BEKELE JEBESSA

SCALE: NORMAL TO SCALE
DATE: NOVEMBER, 2011

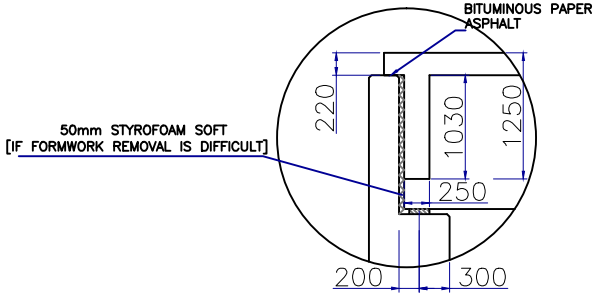
TITLE: 16m SPAN RC DECK GIRDER SUPERSTRUCTURE; WIDTH 7.30m.
SHEET 2/2
DRAWING No.: B - 10



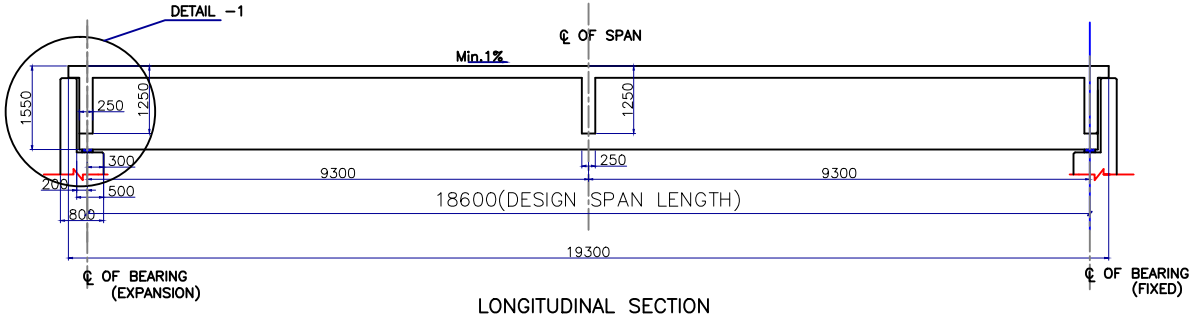
PLAN



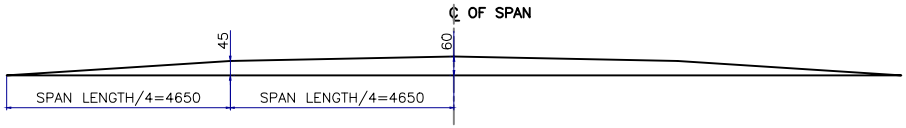
TYPICAL CROSS SECTION



DETAIL–1



LONGITUDINAL SECTION



CAMBER TO BE PROVIDED BENEATH GIRDERS

GENERAL NOTES:

MANUALS USED–THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL

LOADINGS USED : – HL–93 ACCORDING

ALL DIMENSIONS ARE IN MILLIMETERS.

MATERIAL PROPERTIES (STRENGTH)

CONCRETE :– THE MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS SHALL BE 24MPa (C–30).

REINFORCEMENT STEEL:– THE MINIMUM YIELD STRENGTH OF DEFORMED BAR SHALL BE 400 MPA(FOR DIAM>=20MM) AND 300 FOR BARS(DIAM<20MM) IN ACCORDANCE WITH ERA BRIDGE DESIGN MANUAL–2011

ALL BAR DIMENSIONS ARE MEASURED OUT TO OUT

OVERLAP ø12, –300mm. ø16, –400mm. ø32, –1880mm.

FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION

NOTE:– PROVIDE MINIMUM 1% LONGITUDINAL SLOPE FOR DRAINAGE

ON CROSS SECTION DRAWING DIFFERENT GUARDRAIL IS ONLY TO SHOW THE TYPES BUT DURING CONSTRUCTION IT SHALL BE THE SAME TYPE AS PER THE CONSULTANT PREFERENCE.

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
ETHIOPIAN ROADS AUTHORITY

PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
STANDARD DRAWINGS

REVISION
DATE:

EDITED BY: STEPHEN KIRSTEN

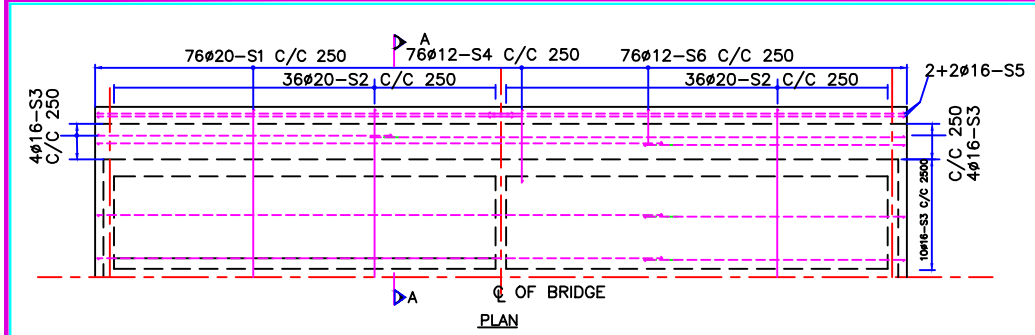
DRAWN BY: ADANECH T.
DESIGNED BY: ASHENAFI L. / SAMUEL G.
CHECKED BY: TESHOME W. / Mr. YOSHINORI OBATA
APPROVED BY: BEKELE JEBESSA

SCALE: NORMAL TO SCALE

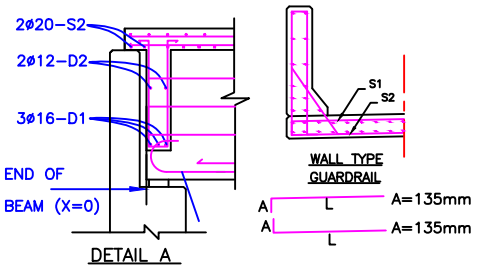
DATE: NOVEMBER, 2011

TITLE: 18m SPAN RC DECK GIRDER SUPERSTRUCTURE; WIDTH 7.30m.
SHEET 1/2

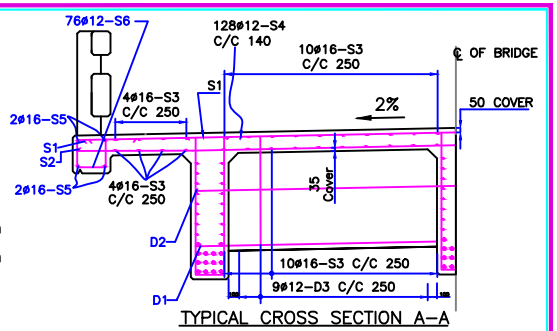
DRAWING No.: B - 11



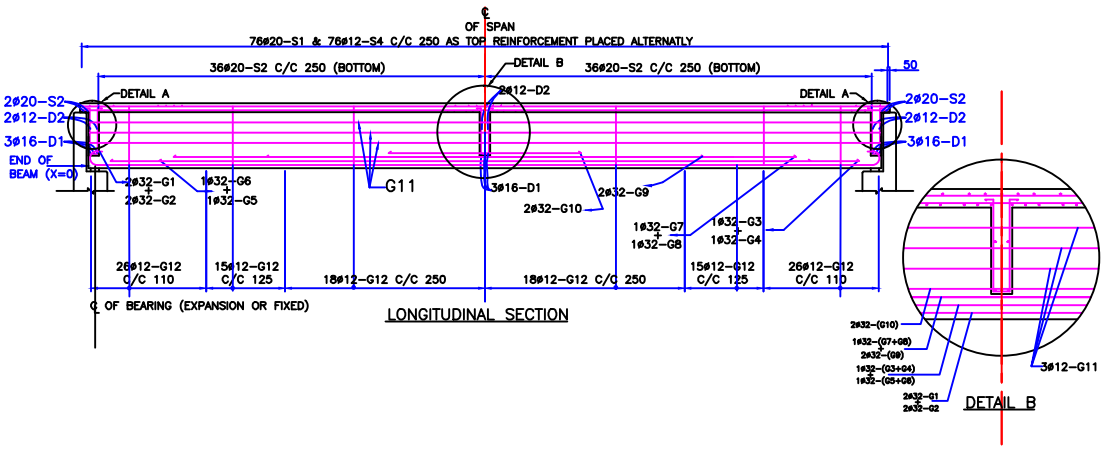
PLAN



DETAIL A



TYPICAL CROSS SECTION A–A



LONGITUDINAL SECTION

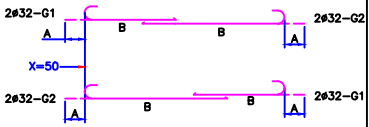
DETAIL B

BAR	SIZE (mm)	NUMBER	BAR TYPE	DIMENSIONS (mm)								BAR LENGTH (mm)	TOTAL LENGTH (m)	TOTAL WEIGHT (Kg)
				A	B	C	D	E	F	G	J			
D1	16	9	Str.	–	–	–	–	–	–	–	–	5516	49.64	77.67
D2	12	6	Str.	–	–	–	–	–	–	–	–	5516	33.09	29.12
D3	12	54	*	100	1150	200	1150	–	–	100	–	2500	135.00	120.00
G1	32	12	*	470	8850	–	–	–	–	–	320	9320	111.84	699.87
G2	32	12	*	470	11530	–	–	–	–	–	320	12000	144	901.12
G3	32	6	Str.	–	–	–	–	–	–	–	–	8800	52.8	330.41
G4	32	6	Str.	–	–	–	–	–	–	–	–	12000	72	450.56
G5	32	6	Str.	–	–	–	–	–	–	–	–	7645	45.87	287.04
G6	32	6	Str.	–	–	–	–	–	–	–	–	12000	72	450.56
G7	32	6	Str.	–	–	–	–	–	–	–	–	7298	43.79	274.02
G8	32	6	Str.	–	–	–	–	–	–	–	–	12000	72	450.56
G9	32	6	Str.	–	–	–	–	–	–	–	–	8152	48.91	306.08
G10	32	6	Str.	–	–	–	–	–	–	–	–	4150	24.9	155.82
G11	16	48	Str.	–	–	–	–	–	–	–	–	18500	888	1389.23
G12	12	354	*	190	1450	300	1460	–	–	190	–	3600	1274.4	1131.70
S1	16	76	Str.	–	–	–	–	–	–	–	–	8070	613.32	1513.06
S2	16	76	Str.	–	–	–	–	–	–	–	–	8070	613.32	1513.06
S3	12	56	Str.	–	–	–	–	–	–	–	–	18500	1036.0	1635.84
S4	12	152	Str.	–	–	–	–	–	–	–	–	1750	266.0	236.21
S5	16	8	Str.	–	–	–	–	–	–	–	–	18500	148	233.69
S6	12	152	*	–	750	280	350	280	200	–	–	1860	282.72	251.06

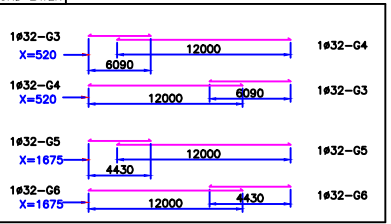
* See details on this sheet

Str.---Implies straight bars.

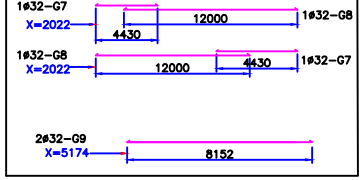
FIRST LAYER BAR SCHEDULE



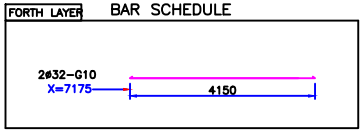
SECOND LAYER

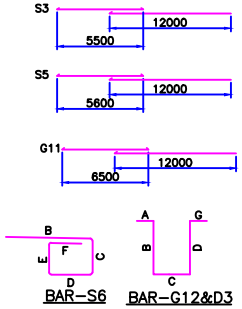


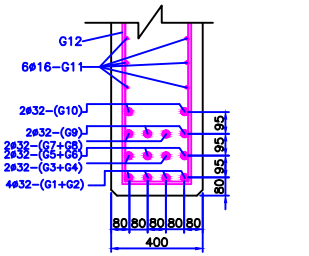
THIRD LAYER



FORTH LAYER BAR SCHEDULE







GIRDER REINFORCEMENT DETAIL

NOTE: THE SPLICING OF BAR G'S SHALL BE VERTICALLY AS SHOWN BELOW

SPLICED BAR

QUANTITIES
REINFORCEMENT: 12,436.60Kg.
CONCRETE: 71.20m³

GENERAL NOTES:
MANUALS USED–THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
LOADINGS USED :– HL–93 ACCORDING
TO CHAPTER 3 OF THE ABOVE SPECIFICATIONS.
ALL DIMENSIONS ARE IN MILLIMETERS.

REINFORCEMENT SUMMARY			
BAR SIZE	12	16	32
TOT. Wt.	3403.93	4726.65	4306.1
GROSS TOT. Wt.---12,436.6kg			

MATERIAL (STRENGTH) PROPERTIES
CONCRETE :– THE MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS SHALL BE 24MPa (C–30).
REINFORCEMENT STEEL:– THE MINIMUM YIELD STRENGTH OF DEFORMED BAR SHALL BE 400 MPA FOR DIAM. >=20mm AND 300 MPA FOR DIA <20mm.
FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION
ALL BAR DIMENSIONS ARE OUT TO OUT
OVERLAP ø12, –400mm. ø16, –500mm. ø20, –800mm. ø24, –1000mm. ø30, –1600mm. ø32, –1800mm.

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
ETHIOPIAN ROADS AUTHORITY

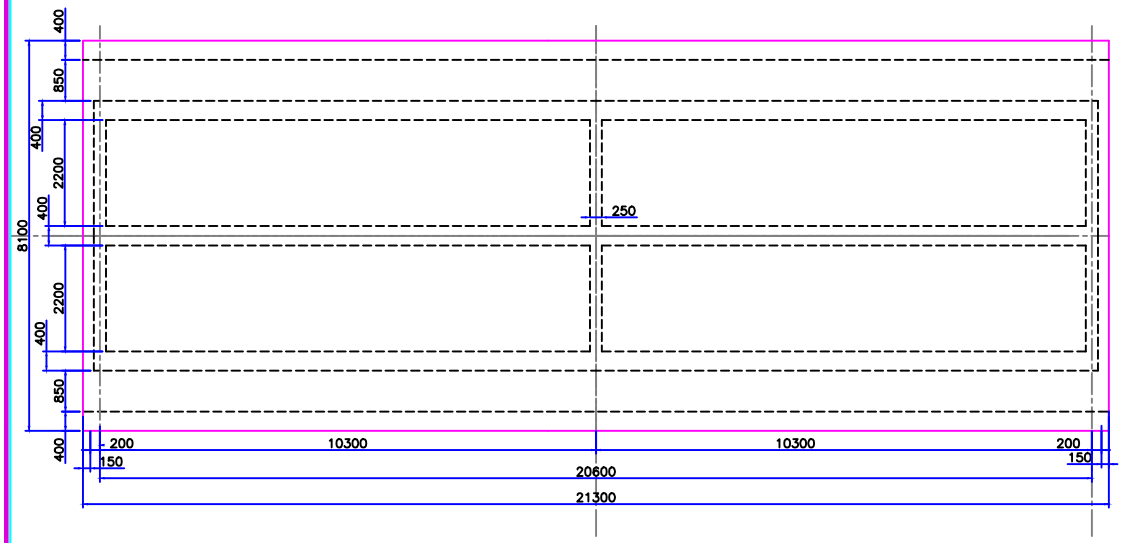
PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
STANDARD DRAWINGS

REVISION
DATE:
EDITED BY: STEPHEN KIRSTEN

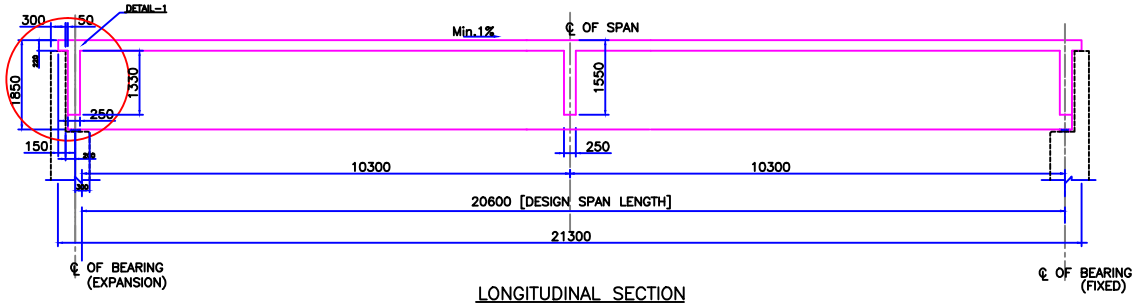
DRAWN BY: ADANECH T.
DESIGNED BY: ASHENAFI L. / SAMUEL G.
CHECKED BY: TESHOME W. / Mr. YOSHINORI OBATA
APPROVED BY: BEKELE JEBESSA

SCALE: NORMAL TO SCALE
DATE: NOVEMBER, 2011

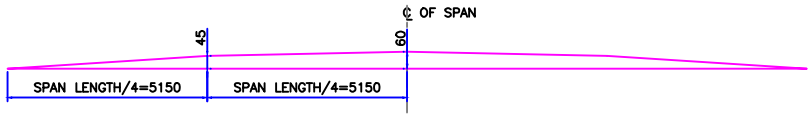
TITLE: 18m SPAN RC DECK GIRDER SUPERSTRUCTURE; WIDTH 7.30m.
SHEET 2/2
DRAWING No.: B - 12



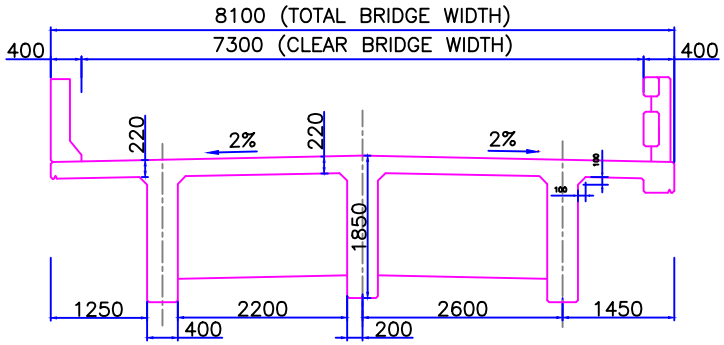
PLAN



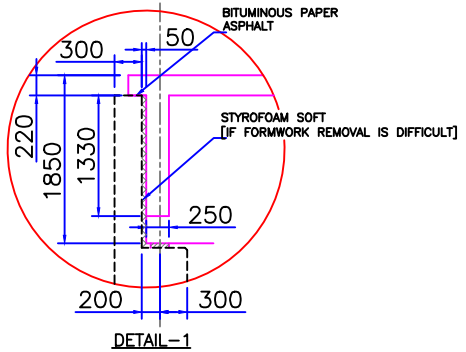
LONGITUDINAL SECTION



CAMBER TO BE PROVIDED BENEATH GIRDERS



TYPICAL CROSS SECTION



DETAIL-1

GENERAL NOTES:

MANUALS USED—THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL

LOADINGS USED : — HL—93 ACCORDING

ALL DIMENSIONS ARE IN MILLIMETERS.

MATERIAL PROPERTIES (STRENGTH)

CONCRETE :— THE MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS SHALL BE 24MPa (C—30).

REINFORCEMENT STEEL:— THE MINIMUM YIELD STRENGTH OF DEFORMED BAR SHALL BE 400 MPA(FOR DIAM>=20MM) AND 300 FOR BARS(DIAM<20MM) IN ACCORDANCE WITH ERA BRIDGE DESIGN MANUAL—2011

ALL BAR DIMENSIONS ARE MEASURED OUT TO OUT

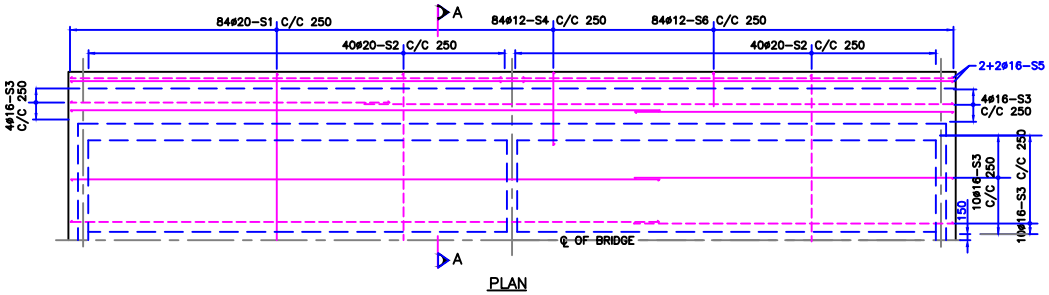
OVERLAP ø12, —400mm. ø16, —500mm. ø32, —1800mm.

FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION

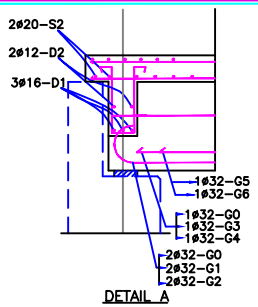
NOTE:— PROVIDE MINIMUM 1% LONGITUDINAL SLOPE FOR DRAINAGE

ON CROSS SECTION DRAWING DIFFERENT GUARDRAIL IS ONLY TO SHOW THE TYPES BUT DURING CONSTRUCTION IT SHALL BE THE SAME TYPE AS PER THE CONSULTANT PREFERENCE.

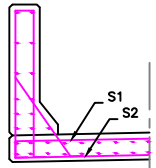
THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA ETHIOPIAN ROADS AUTHORITY	REVISION DATE:	DRAWN BY: ADANECH T.	SCALE:	TITLE: 20m SPAN RC DECK GIRDER SUPERSTRUCTURE; WIDTH 7.30m.
PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL STANDARD DRAWINGS	EDITED BY: STEPHEN KIRSTEN	DESIGNED BY: ASHENAFI L. / SAMUEL G. CHECKED BY: TESHOME W. / Mr. YOSHINORI OBATA APPROVED BY: BEKELE JEBESSA	NORMAL TO SCALE DATE: NOVEMBER, 2011	SHEET 1/2 DRAWING No.: B -13



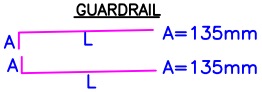
PLAN

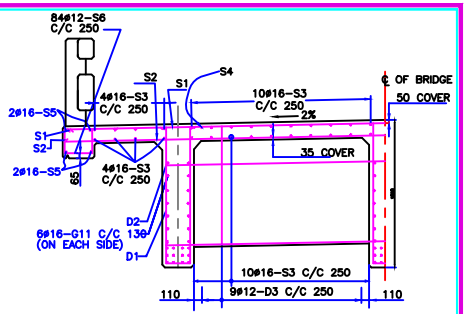


DETAIL A

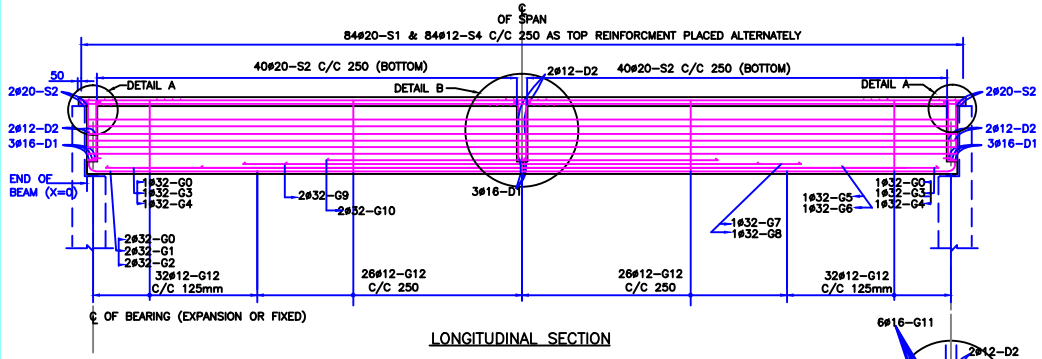


WALL TYPE GUARDRAIL

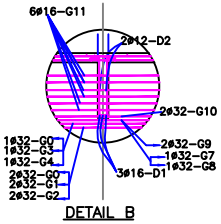




TYPICAL CROSS–SECTION A–A



LONGITUDINAL SECTION



DETAIL B

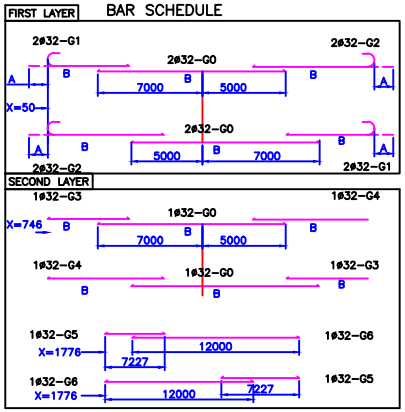
REINFORCING BAR SCHEDULE

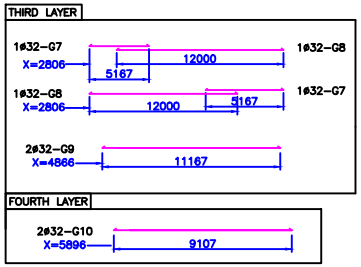
BAR MARK	SIZE (mm)	NUMBER	BAR TYPE	DIMENSIONS (mm)								BAR LENGTH (mm)	TOTAL LENGTH (m)	TOTAL WEIGHT (Kg)
				A	B	C	D	E	F	G	J			
D1	16	9	Str.	–	–	–	–	–	–	–	–	5530	49.77	79
D2	12	6	Str.	–	–	–	–	–	–	–	–	5530	33.18	30
D3	12	54	*	100	1475	200	1475	–	–	100	–	3350	180.90	161
G0	32	18	*	–	12000	–	–	–	–	–	–	12000	216	1364
G1	32	12	*	470	5280	–	–	–	–	–	320	5750	69	436
G2	32	12	*	470	7280	–	–	–	–	–	320	7750	93	588
G3	32	6	Str.	–	–	–	–	–	–	–	–	4584	27.50	174
G4	32	6	Str.	–	–	–	–	–	–	–	–	6584	39.50	250
G5	32	6	Str.	–	–	–	–	–	–	–	–	7227	43.36	274
G6	32	6	Str.	–	–	–	–	–	–	–	–	12000	72	455
G7	32	6	Str.	–	–	–	–	–	–	–	–	5167	31.00	196
G8	32	6	Str.	–	–	–	–	–	–	–	–	12000	72	455
G9	32	6	Str.	–	–	–	–	–	–	–	–	11167	67.00	423
G10	32	6	Str.	–	–	–	–	–	–	–	–	9107	54.64	345
G11	16	36	Str.	–	–	–	–	–	–	–	–	21200	763.20	1204
G12	12	348	*	100	1750	300	1750	–	–	100	–	4000	1392.0	1236
G13	16	18	Str.	–	–	–	–	–	–	–	–	20850	375.30	594
S1	16	153	Str.	–	–	–	–	–	–	–	–	8070	677.88	1672
S2	16	120	Str.	–	–	–	–	–	–	–	–	8070	677.88	1672
S3	12	96	Str.	–	–	–	–	–	–	–	–	21500	1204.0	1901
S4	12	306	Str.	–	–	–	–	–	–	–	–	1750	294.0	261
S5	16	8	Str.	–	–	–	–	–	–	–	–	21500	172	272
S6	12	144	*	–	750	280	350	280	200	–	–	1860	312.48	278

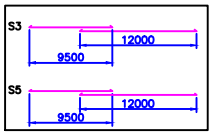
* See details on this sheet

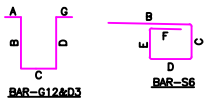
Str.---implies straight bars.

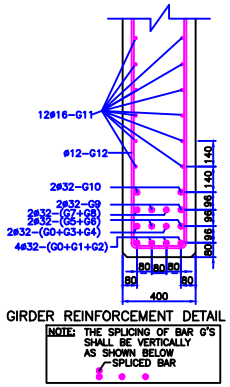
BAR SCHEDULE











GIRDER REINFORCEMENT DETAIL

NOTE: THE SPLICING OF BAR G'S SHALL BE VERTICALLY AS SHOWN BELOW –SPLICED BAR

QUANTITIES
REINFORCEMENT: 14,320Kg.
CONCRETE: 86.00m^3

GENERAL NOTES:
MANUALS USED–THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
LOADINGS USED :– HL–93 ACCORDING
TO CHAPTER 3 OF THE ABOVE SPECIFICATIONS.
ALL DIMENSIONS ARE IN MILLIMETERS.

REINFORCEMENT SUMMARY			
BAR SIZE	12	16	32
TOT. Wt.	3867	5493	4960
GROSS TOT. Wt.------14,320kg			

MATERIAL (STRENGTH) PROPERTIES
CONCRETE :– THE MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS SHALL BE 24MPa (C–30).
REINFORCEMENT STEEL:– THE MINIMUM YIELD STRENGTH OF DEFORMED BAR SHALL BE 400 MPA FOR DIAM. >=20mm AND 300 MPA FOR DIA <20mm.
FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION
ALL BAR DIMENSIONS ARE OUT TO OUT
OVERLAP ø12, –400mm. ø16, –500mm. ø20, –800mm. ø24, –1000mm. ø30, –1600mm. ø32, –1800mm.

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
ETHIOPIAN ROADS AUTHORITY

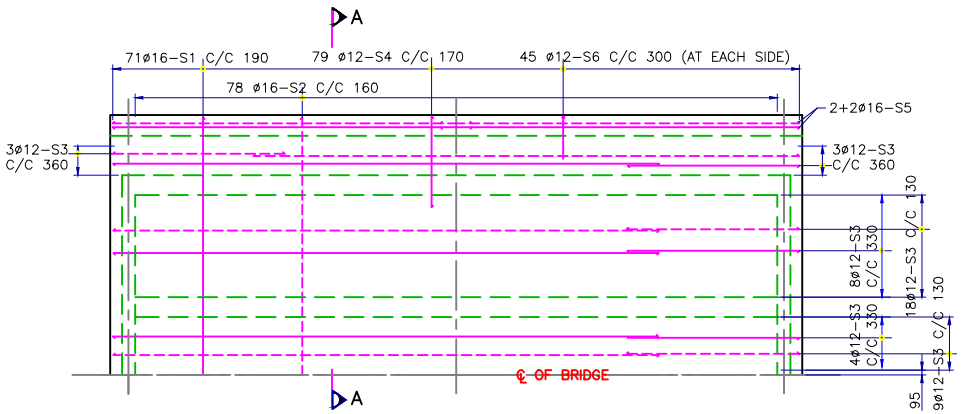
PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
STANDARD DRAWINGS

REVISION
DATE:
EDITED BY: STEPHEN KIRSTEN

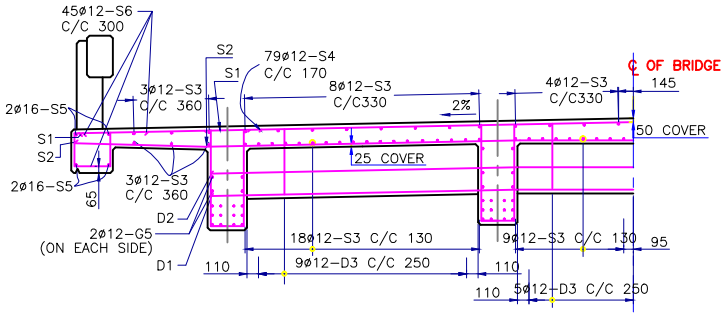
DRAWN BY: ADANECH T.
DESIGNED BY: ASHENAFI L. / SAMUEL G.
CHECKED BY: TESHOME W. / Mr. YOSHINORI OBATA
APPROVED BY: BEKELE JEBESSA

SCALE: NORMAL TO SCALE
DATE: NOVEMBER, 2011

TITLE: 20m SPAN RC DECK GIRDER SUPERSTRUCTURE; WIDTH 7.30m.
SHEET 2/2
DRAWING No.: B - 14



PLAN (SCALE 1:50)



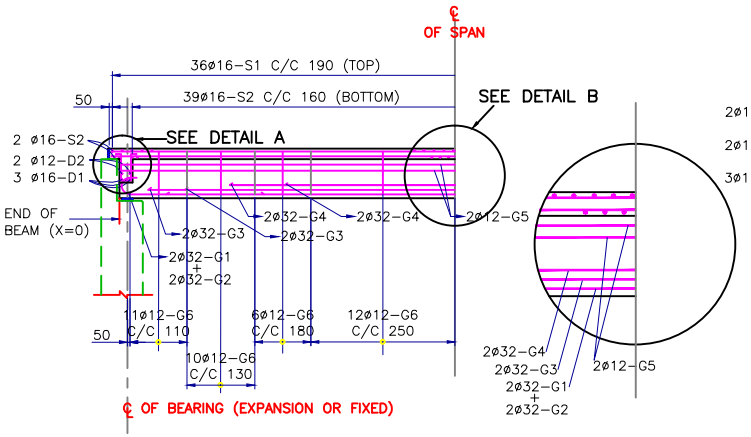
TYPICAL CROSS SECTION A–A (SCALE 1:25)

REINFORCING BAR SCHEDULE

BAR MARK	SIZE (mm)	NUMBER	BAR TYPE	DIMENSIONS (MM) A	B	C	D	E	F	G	J	BAR LENGTH (mm)	TOTAL LENGTH (m)	TOTAL WEIGHT (Kg)
D1	16	6	Str.	–	–	–	–	–	–	–	–	8130	48.78	77
D2	12	4	Str.	–	–	–	–	–	–	–	–	8130	32.52	29
D3	12	54	*	100	550	200	550	–	–	100	–	1500	81.00	72
G1	32	16	*	470	3160	–	–	–	–	–	320	3630	58.08	367
G2	32	16	*	470	11530	–	–	–	–	–	320	12000	192.00	1212
G3	32	16	Str.	–	–	–	–	–	–	–	–	11090	177.44	1120
G4	32	16	Str.	–	–	–	–	–	–	–	–	7600	121.60	768
G5	12	16	Str.	–	–	–	–	–	–	–	–	13150	210.40	187
G6	12	231	*	100	910	300	910	–	–	100	–	2320	535.92	476
S1	16	71	Str.	–	–	–	–	–	–	–	–	10750	763.25	1205
S2	16	82	Str.	–	–	–	–	–	–	–	–	10750	881.50	1391
S3	12	84	Str.	–	–	–	–	–	–	–	–	13500	1134.00	1007
S4	12	158	Str.	–	–	–	–	–	–	–	–	1790	282.82	251
S5	16	8	Str.	–	–	–	–	–	–	–	–	13600	108.80	172
S6	12	90	*	–	750	280	350	280	200	–	–	1860	167.40	149

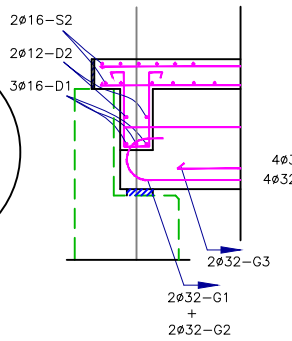
* See details this sheet
Str.---IMPLIES STRAIGHT BARS.

NOTE:
STRUCTURE DIMENSION AND REINFORCEMENT ARE SYMMETRICAL ABOUT ℄ OF BRIDGE AND ℄ OF SPAN

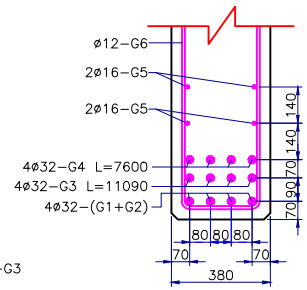


LONGITUDINAL SECTION (SCALE 1:50)

DETAIL B (SCALE 1:25)



DETAIL A (SCALE 1:25)



GIRDER REINFORCEMENT DETAIL (SCALE 1:10)

NOTE:
THE SPLICING OF BAR G'S SHALL BE VERTICALLY AS SHOWN BELOW
SPLICED BAR

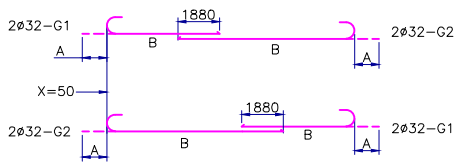
QUANTITIES
REINFORCEMENT: 8481 Kg.
CONCRETE: 54.74m³

REINFORCEMENT SUMMARY			
BAR SIZE	12	16	32
TOT. Wt.	2170	2845	3467
GROSS TOT. Wt.----8481kg			

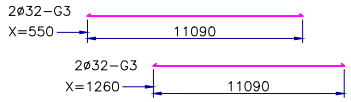
GENERAL NOTES:
MANUALS USED–THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
LOADINGS USED :– HL–93 ACCORDING
TO CHAPTER 3 OF THE ABOVE SPECIFICATIONS.
FOR DIMENSIONS : SEE DWG NO. B –14
FOR STANDARD BAR DETAILS : SEE DWG NO. B – 28
PROVIDE 25mm CHAMFER AT ALL EDGES.
ALL DIMENSIONS ARE IN MILLIMETERS.
MATERIAL (STRENGTH) PROPERTIES
CONCRETE :– THE MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS SHALL BE 20MPa (GRADE 20).
REINFORCEMENT STEEL :– THE MINIMUM YIELD STRENGTH OF DEFORMED BAR SHALL BE 500 MPA IN ACCORDANCE WITH ERA BRIDGE DESIGN MANUAL–2001
FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION
ALL BAR DIMENSIONS ARE OUT TO OUT
OVERLAP ø12, –300mm. ø16, –400mm. ø32, –1880mm.

BAR SCHEDULE

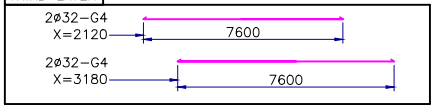
FIRST LAYER

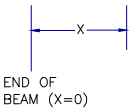


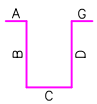
SECOND LAYER



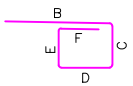
THIRD LAYER



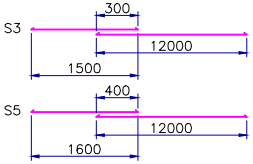




BAR–G6&D3



BAR–S6



NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

REVISIONS

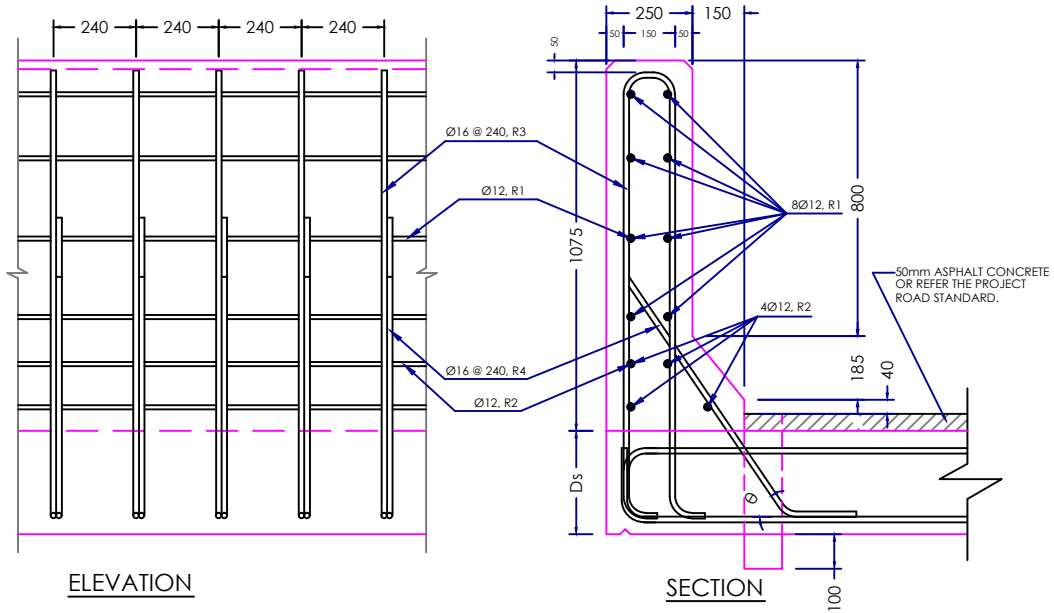
THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
ETHIOPIAN ROADS AUTHORITY
Post Office Box 1770 Addis Ababa Ethiopia
Cable Address Highways Addis Ababa
Telex 21180 Tel.No. 51–71–70/79

BRIDGE RC DECK GIRDER 12m. SPAN; WIDTH 10m.

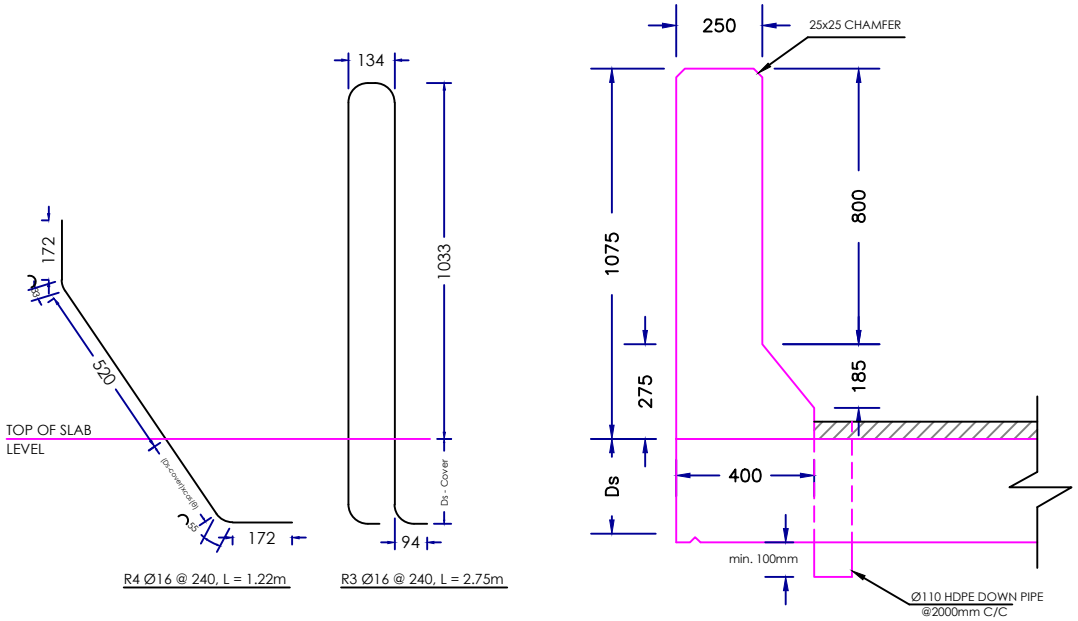
SHEET 2/2

DRAWN	SISAY GETU
DESIGNED	HENOK A.
CHECKED	L. RAHM
APPROVED	BEKELE JEBESSA
EDITED	STEPHEN KIRSTEN

SCALE: AS SHOWN
DATE: 16/11/98
DRG. NO.: B – 15



WALL TYPE GUARD RAIL QUANTITY PER METER LENGTH							
REINFORCEMENT BARS							Concrete (m3)
	Dia (mm)	Length (mm)	Spacing (mm)	Number	Total Length (m)	Weight (kg)	(C30)
BAR R1	12	1000	As shown	8	8.00	7.10	**0.296**
BAR R2	12	1000	As shown	4	4.00	3.55	
BAR R3	16	2750	240	6	16.50	26.05	
BAR R4	16	1220	240	6	7.32	11.56	
					TOTAL QUANTITY =	**48.26**	



NOTES

CONCRETE: CLASS OF CONCRETE SHALL BE WITH A MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH OF 24 MPa AFTER 28 DAYS(C–30).

REINFORCEMENT: DEFORMED BARS WITH A MIN. YIELD STRENGTH OF 300 MPA IN ACCORDANCE WITH ERA BRIDGE DESIGN MANUAL

ALL CONCRETE EDGES SHALL BE CHAMFERED 25mm.

RAILING SHALL NOT BE ERECTED UNTIL FALSE WORK UNDER SUPERSTRUCTURE HAS BEEN REMOVED AND THE SPAN IS SELF SUPPORTING.

FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION.

DIMENSIONS ARE OUT TO OUT OF BARS MIN.

ALL DIMENSIONS ARE IN mm.

LENGTHS OF BAR R3 & R4 VARY WITH DEPTH OF OVERHANG SLAB THICKNESS, Ds.

DOWN PIPES SHALL EXTEND AT LEAST 10cm DOWN UNDER THE SOFFIT OF THE DECK.

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
ETHIOPIAN ROADS AUTHORITY

PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
STANDARD DRAWINGS

REVISION
DATE:

EDITED BY: STEPHEN KIRSTEN

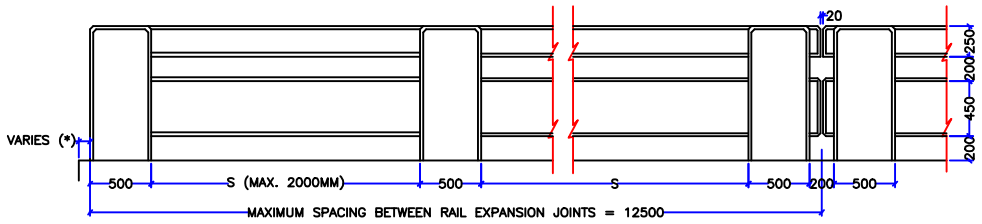
DRAWN BY: ADANECH T.
DESIGNED BY: ASHENAFI L. / SAMUEL G.
CHECKED BY: TESHOME W. / Mr. YOSHINORI OBATA
APPROVED BY: BEKELE JEBESSA

SCALE: NTSC

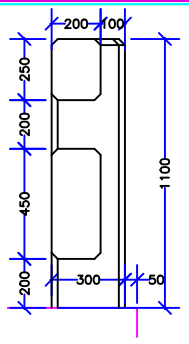
DATE: NOVEMBER, 2011

TITLE: CONCRETE GUARD RAIL (WALL TYPE)

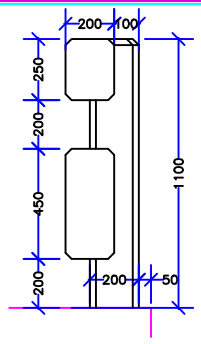
DRAWING No.: B - 16



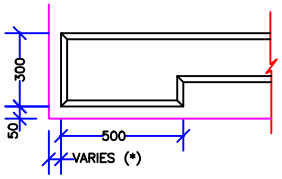
ELEVATION



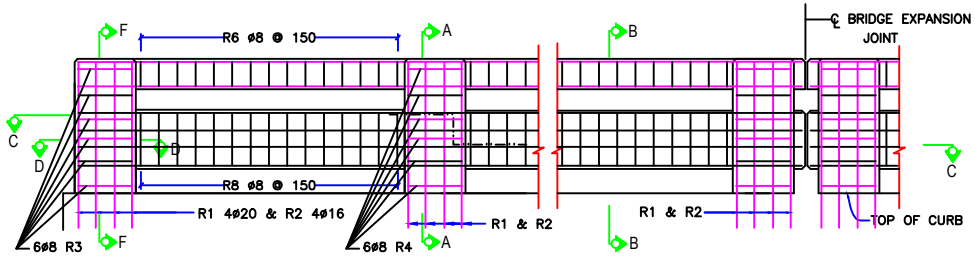
SECTION F-F



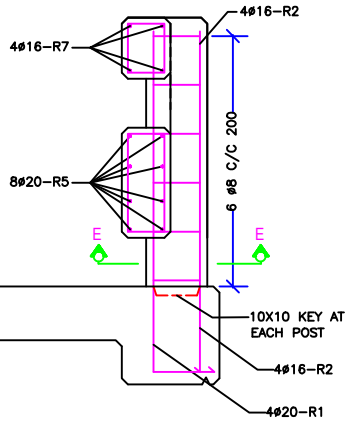
SECTION B-B

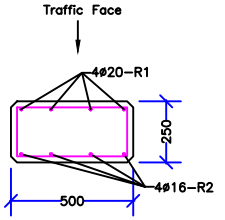


PLAN OF END POST

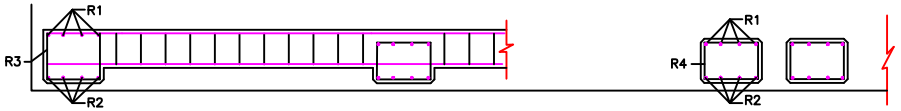


ELEVATION SHOWING REINFORCEMENT





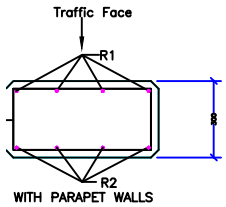
SECTION E-E



SECTION C-C

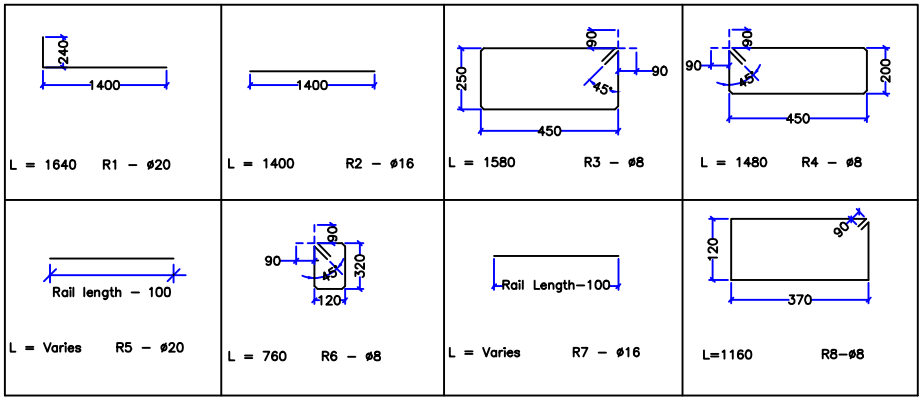
NOTE : BRIDGE REINFORCEMENT NOT SHOWN

SECTION A-A



WITH PARAPET WALLS

SECTION D-D



NOTES

LOADING USED: AS PER PREVAILING VERSION OF AASHTO (DO NOT SATISFY PREVAILING VERSION OF AASHTO LOADING)

CONCRETE: MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH OF 24 MPa. AFTER 28 DAYS.

REINFORCEMENT: DEFORMED BARS WITH A MIN. YIELD STRENGTH OF 400 MPA FOR BAR DIA.>=20mm AND 300 MPA FOR BAR DIA.<20mm.

ALL CONCRETE EDGES SHALL BE CHAMFERED 25mm.

RAILS AND POST SHALL BE GIVEN A RUBBED FINISH IN ACCORDANCE WITH E.R.A. SPECIFICATIONS.

RAILING SHALL NOT BE ERECTED UNTIL FALSE WORK OF SUPERSTRUCTURE HAS BEEN REMOVED AND THE SPAN IS SELF SUPPORTING.

FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION

DIMENSIONS OF BAR ARE OUT TO OUT. MINIMUM BENDING PIN DIAMETER TO BE 5 TIMES BAR DIAMETER. ø=BAR DIAMETER IN mm.

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
ETHIOPIAN ROADS AUTHORITY

THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL STANDARD DRAWINGS

REVISION
DATE:

EDITED BY: STEPHEN KIRSTEN

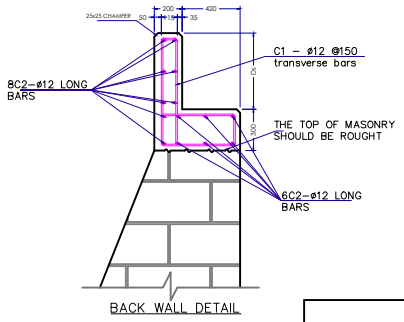
DRAWN BY: ADANECH T.
DESIGNED BY: ASHENAFI L. / SAMUEL G.
CHECKED BY: TESHOME W. / Mr. YOSHINORI OBATA
APPROVED BY: BEKELE JEBESSA

SCALE: NTSC

DATE: NOVEMBER, 2011

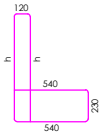
TITLE: CONCRETE GUARD RAIL (PILLAR TYPE)

DRAWING No.: B - 17



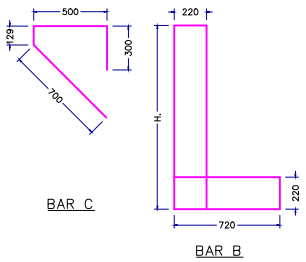
BACK WALL DETAIL

REINFORCEMENT SUMMARY (BACK WALL)			
SLAB SPAN	6.0m	8.0m	10.0m
BAR SIZE	12	12	12
TOT. Wt.	201.0	205.0	209.4



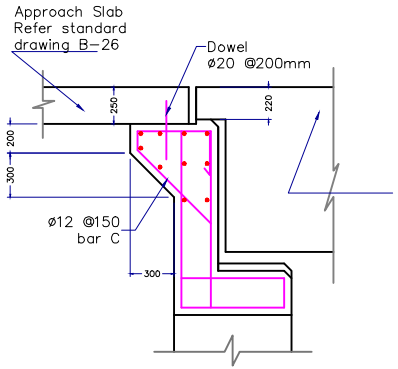
C1 – ø12@150
Transverse bars

QUANTITY OF ONE SIDE BACK WALL								
BAR	DIA. (mm)	No.	LENGTH (m) for Span 6m	LENGTH (m) for Span 8m	LENGTH (m) for Span 10m	TOTAL LENGTH (m)	TOTAL WEIGHT (Km)	BAR SHAPE
C1	12	55	2.08	2.16	2.25	---	---	As shown
C2	12	14	8.00			112.0	99.46	8.00
CONCRETE(m3)			2.12	2.26	2.39			

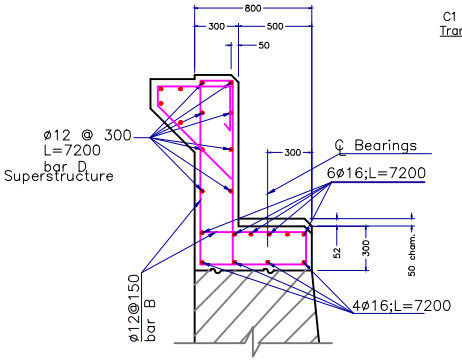


BAR C

BAR B



APPROACH SLAB SEAT
DETAIL



QUANTITY OF ONE SIDE BACK WALL									
BAR	DIA. (mm)	No.	LENGTH (m) for Span 12m	for Span 14m	for Span 16m	for Span 18m	for Span 20m	TOTAL LENGTH (m)	TOTAL WEIGHT (Km)	BAR SHAPE
B	12	50	3.98	4.38	4.88	5.08	5.68	---	---	As shown
C	12	50	1.63	1.63	1.63	1.63	1.63	---	---	As shown
D	12	--	7.20					---	---	7.20
CONCRETE(m3)			4.58	5.02	5.56	5.78	6.44			

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
ETHIOPIAN ROADS AUTHORITY

PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
STANDARD DRAWINGS

REVISION
DATE:

EDITED BY: STEPHEN KIRSTEN

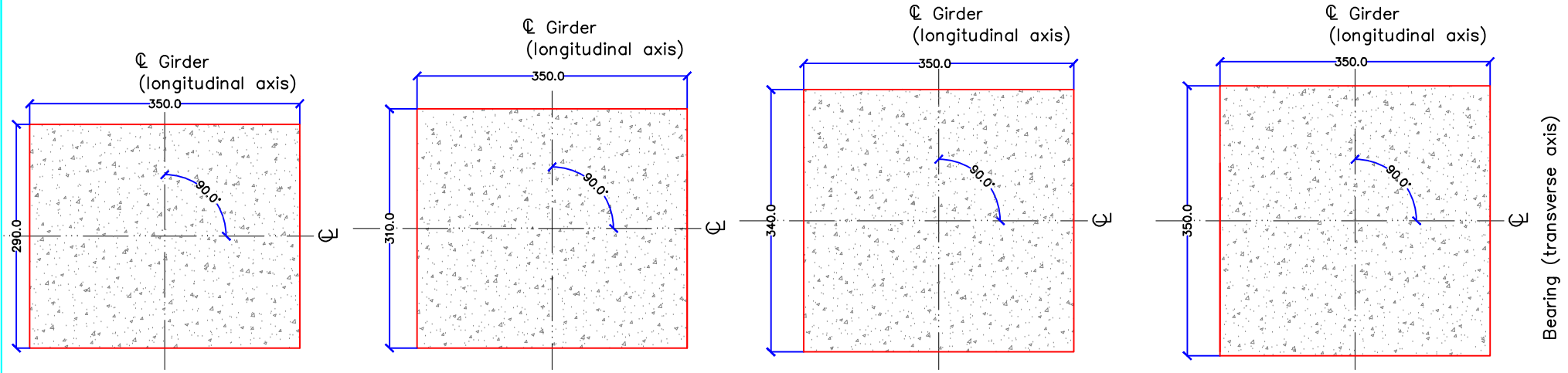
DRAWN BY: ADANECH T.
DESIGNED BY: ASHENAFI L. / SAMUEL G.
CHECKED BY: TESHOME W. / Mr. YOSHINORI OBATA
APPROVED BY: BEKELE JEBESSA

SCALE: Normal to Scale

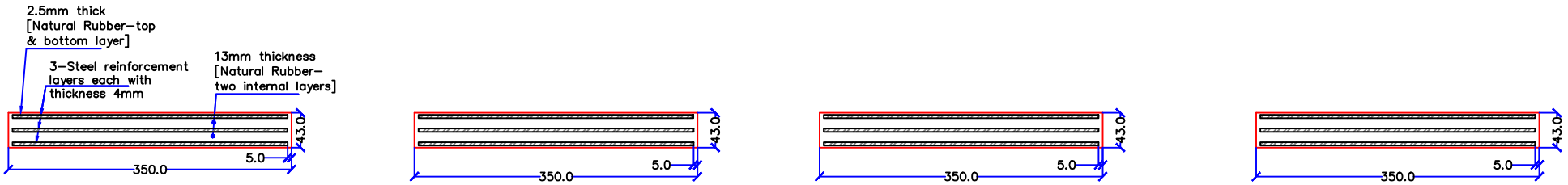
DATE: NOVEMBER, 2011

TITLE: CONCRETE BACK WALL FOR SLAB AND T-GIRDER SUPERSTRUCTURE.

DRAWING No.: B - 18



BEARING PAD PLAN VIEW



For 12.00m &14.00m R.C. Deck Girder

For 16.00 R.C. Deck Girder

For 18m R.C. Deck Girder

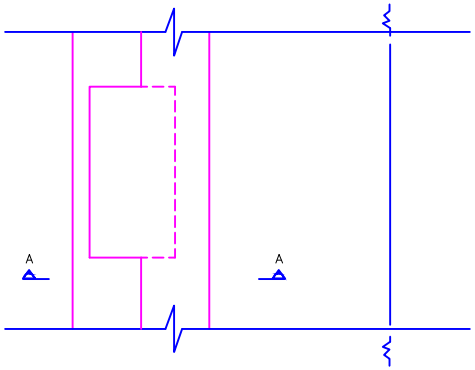
For 20m R.C. Deck Girder

BEARING PAD ELEVATION VIEW

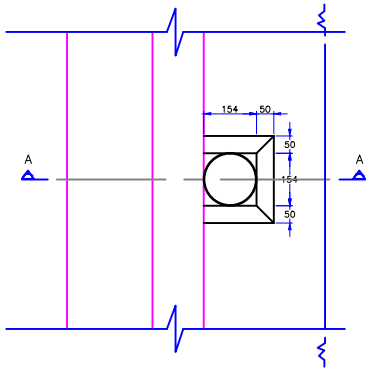
Note:
The design is done using the following material properties. The manufacturer shall officially confirm the satisfaction of these material qualities during construction.

Elastomer Shore hardness, H shore A = 60 Degrees
Elastomer Shear Modulus, G = 1.01Mpa
Yield strength of steel Fy = 250Mpa
The physical properties of Natural Rubber shall conform to the prevailing version of AASHTO M251

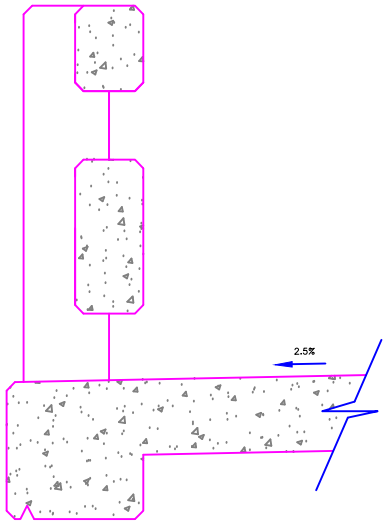
THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA ETHIOPIAN ROADS AUTHORITY PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL STANDARD DRAWINGS	REVISION DATE: EDITED BY: STEPHEN KIRSTEN	DRAWN BY: ADANECH T. DESIGNED BY: ASHENAFI L. / SAMUEL G. CHECKED BY: TESHOME W. / Mr. YOSHINORI OBATA APPROVED BY: BEKELE JEBESSA	SCALE: NTSC DATE: NOVEMBER, 2011	TITLE: ELASTOMER BEARING FOR R.C. DECK GIRDER BRIDGES DRAWING No.: B - 19



TYPICAL DRAIN PLAN

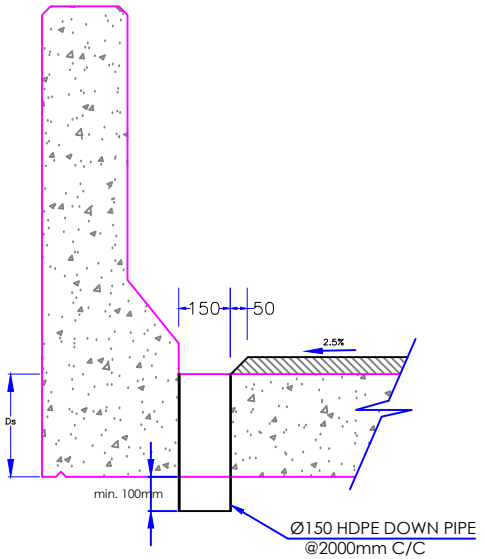


TYPICAL DRAIN PLAN



SECTION A-A

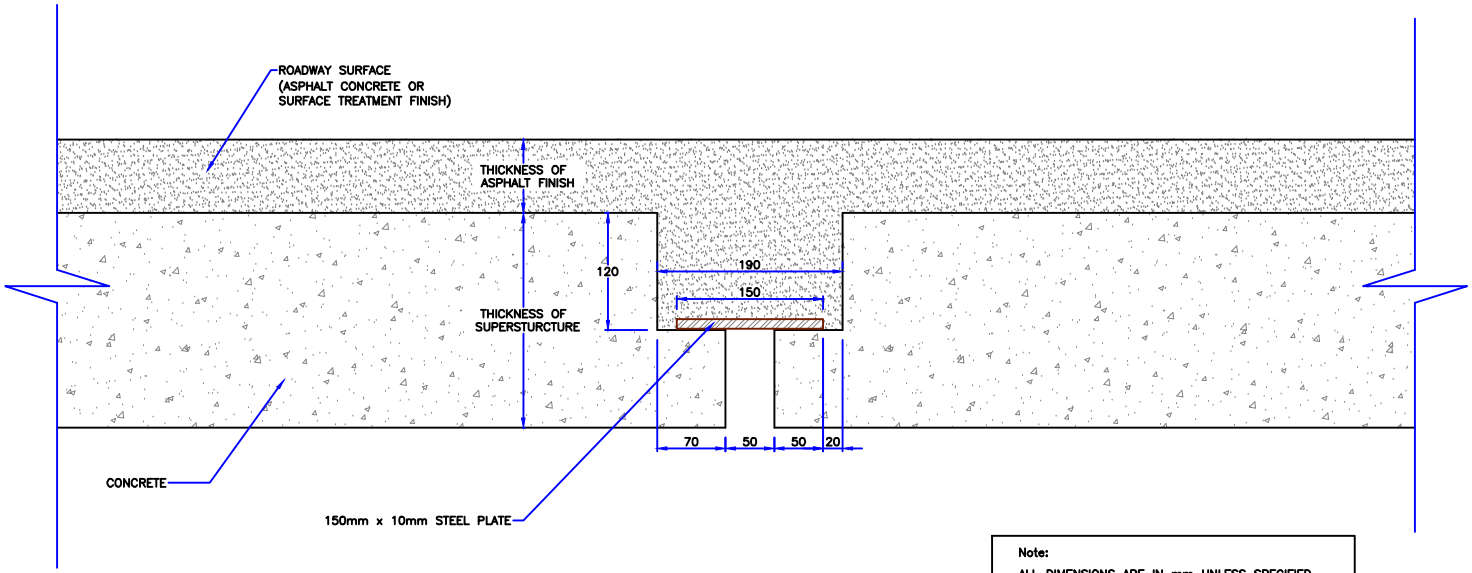
FOR PILLAR TYPE GUARD RAILING



SECTION A-A

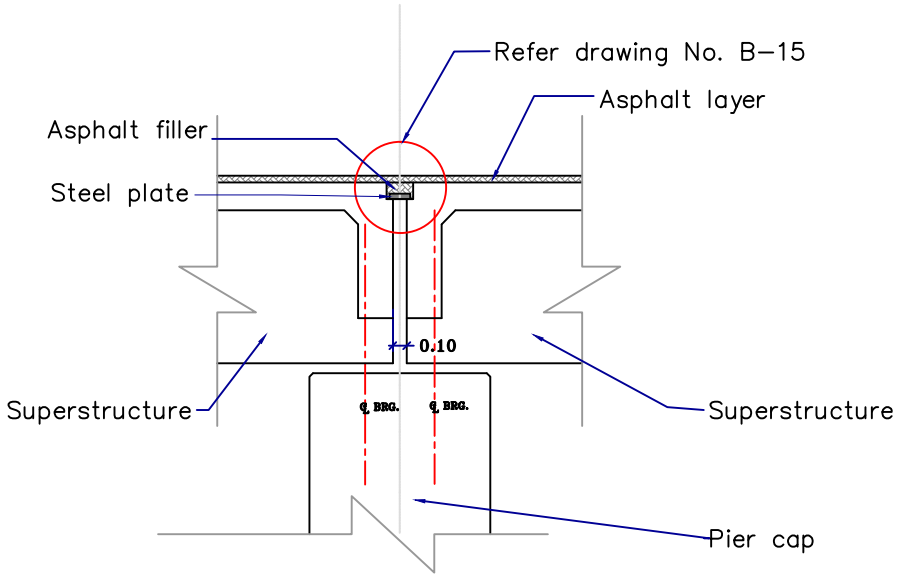
FOR WALL TYPE GUARD RAILING

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA ETHIOPIAN ROADS AUTHORITY	REVISION DATE:	DRAWN BY: ADANECH T.	SCALE:	TITLE:
PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL STANDARD DRAWINGS	EDITED BY: STEPHEN KIRSTEN	DESIGNED BY: ASHENAFI L. / SAMUEL G. CHECKED BY: TESHOME W. / Mr. YOSHINORI OBATA APPROVED BY: BEKELE JEBESSA	Normal to Scale DATE: NOVEMBER, 2011	BRIDGE DECK OUTLET DRAINAGE DRAWING No.: B - 20

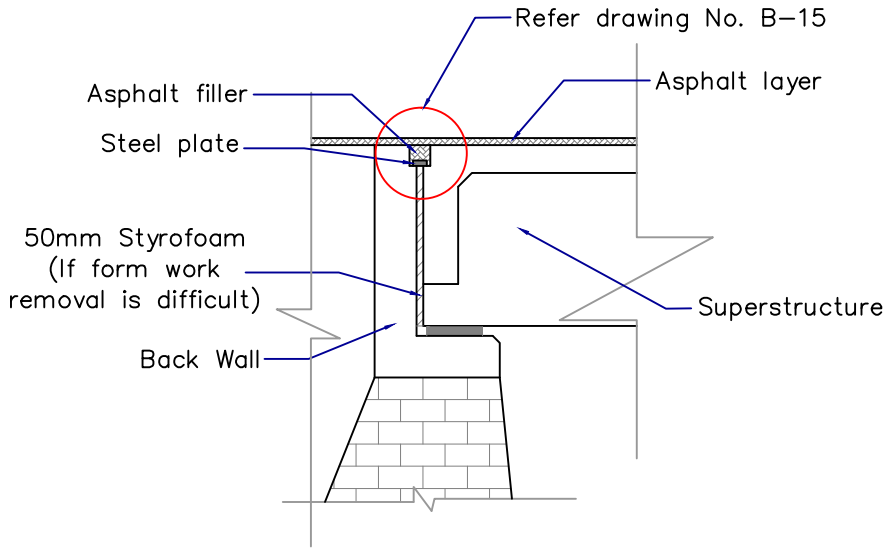


Note:
– ALL DIMENSIONS ARE IN mm UNLESS SPECIFIED.

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA ETHIOPIAN ROADS AUTHORITY	REVISION DATE:	DRAWN BY: ADANECH T.	SCALE:	TITLE:
		DESIGNED BY: ASHENAFI L. / SAMUEL G.	NTSC	ASPHALTIC PLUG TYPE BRIDGE JOINT SYSTEM
PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL STANDARD DRAWINGS		CHECKED BY: TESHOME W. / Mr. YOSHINORI OBATA		
	EDITED BY: STEPHEN KIRSTEN	APPROVED BY: BEKELE JEBESSA	DATE: NOVEMBER, 2011	DRAWING No.: B - 21

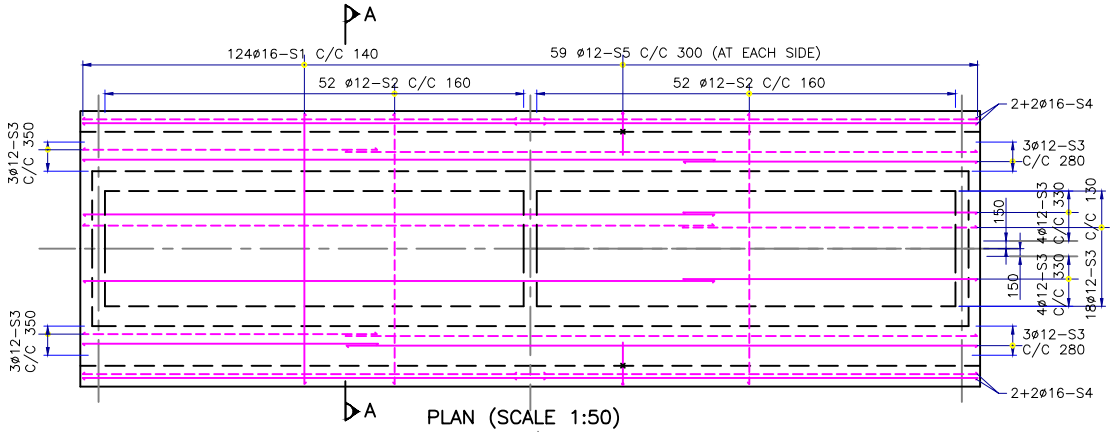


DETAIL OF EXPANSION JOINT ON PIER

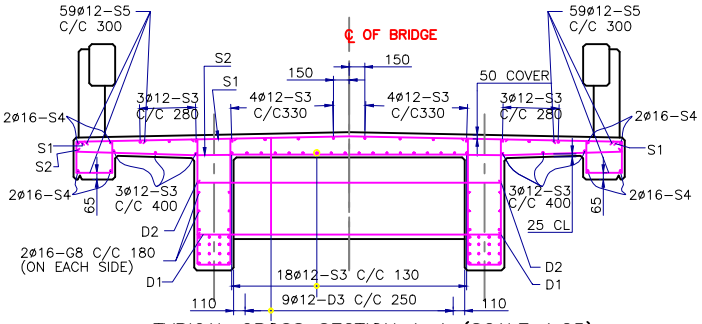


DETAIL OF EXPANSION JOINT ON ABUTMENT

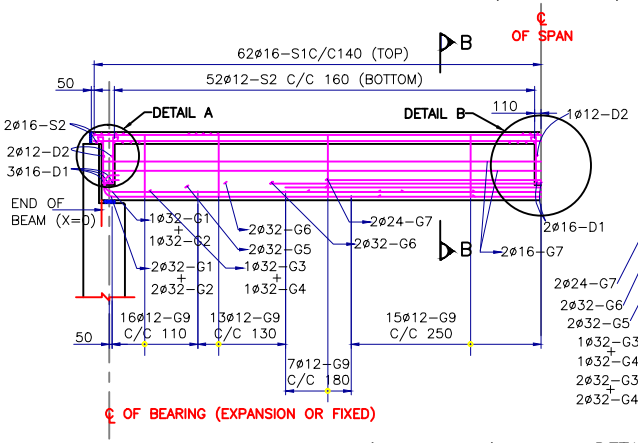
THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA ETHIOPIAN ROADS AUTHORITY PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL STANDARD DRAWINGS	REVISION DATE: EDITED BY: STEPHEN KIRSTEN	DRAWN BY: ADANECH T. DESIGNED BY: ASHENAFI L. / SAMUEL G. CHECKED BY: TESHOME W. / YOSHINORI OBATA APPROVED BY: BEKELE JEBESSA	SCALE: Normal to Scale DATE: NOVEMBER, 2011	TITLE: EXPANSION JOINT DETAIL DRAWING No.: B - 22



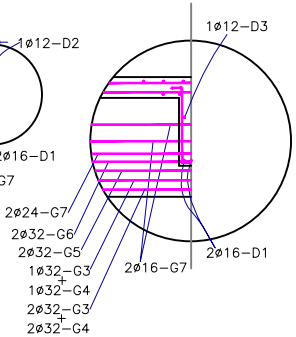
PLAN (SCALE 1:50)



TYPICAL CROSS SECTION A–A (SCALE 1:25)

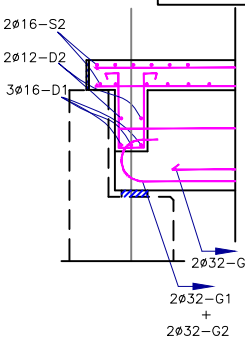


LONGITUDINAL SECTION (SCALE 1:50)

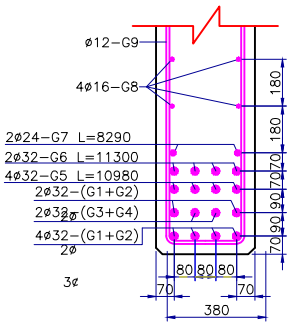


DETAIL B (SCALE 1:25)

NOTE:
STRUCTURE DIMENSION AND REINFORCEMENT ARE SYMMETRICAL ABOUT ℄ OF BRIDGE AND ℄ OF SPAN.



DETAIL A (SCALE 1:25)



GIRDER REINFORCEMENT DETAIL (SCALE 1:10)

REINFORCING BAR SCHEDULE

BAR MARK	SIZE (mm)	NUMBER	BAR TYPE	DIMENSIONS(mm) A	B	C	D	E	F	G	J	BAR LENGTH (mm)	TOTAL LENGTH (m)	TOTAL WEIGHT (Kg)
D1	16	9	Str.	–	–	–	–	–	–	–	–	2930	26.37	42
D2	12	6	Str.	–	–	–	–	–	–	–	–	2930	17.58	16
D3	12	27	*	100	850	200	850	–	–	100	–	2100	56.70	50
G1	32	12	*	470	11530	–	–	–	–	–	320	12000	144.00	909
G2	32	12	*	470	7150	–	–	–	–	–	320	7620	91.44	577
G3	32	4	Str.	–	–	–	–	–	–	–	–	4980	19.92	126
G4	32	4	Str.	–	–	–	–	–	–	–	–	12000	48.00	303
G5	32	8	Str.	–	–	–	–	–	–	–	–	10980	87.84	555
G6	32	8	Str.	–	–	–	–	–	–	–	–	11300	90.40	571
G7	24	4	Str.	–	–	–	–	–	–	–	–	8290	33.16	118
G8	16	8	Str.	–	–	–	–	–	–	–	–	17150	137.20	217
G9	12	202	*	100	1210	300	1210	–	–	100	–	2920	589.84	524
S1	16	124	Str.	–	–	–	–	–	–	–	–	5250	651.00	1027
S2	16	108	Str.	–	–	–	–	–	–	–	–	5250	567.00	895
S3	12	30	Str.	–	–	–	–	–	–	–	–	17500	525.00	466
S4	16	8	Str.	–	–	–	–	–	–	–	–	17600	140.80	222
S5	12	118	*	–	750	280	350	280	200	–	–	1860	219.48	195

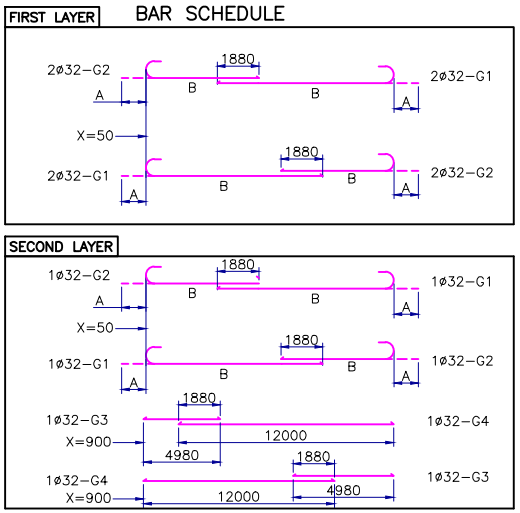
* See details this sheet
Str.---IMPLIES STRAIGHT BARS.

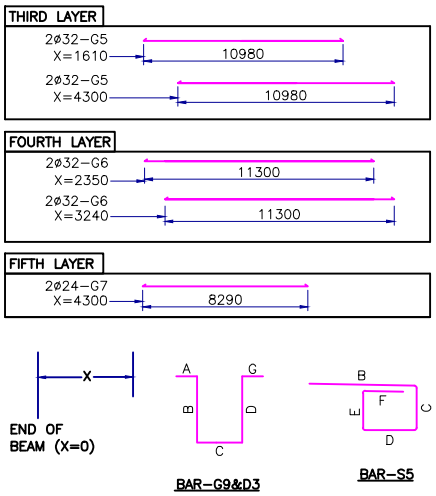
QUANTITIES
REINFORCEMENT: 6812 Kg.
CONCRETE: 38.56m^3

REINFORCEMENT SUMMARY				
BAR SIZE	12	16	24	32
TOT. Wt.	1251	2403	118	3041
GROSS TOT. Wt.------6812kg				

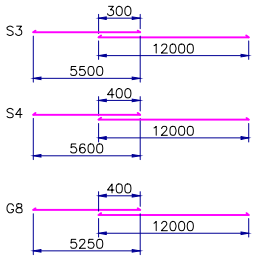
GENERAL NOTES:
MANUALS USED–THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
LOADINGS USED :– HL–93 ACCORDING
TO CHAPTER 3 OF THE ABOVE SPECIFICATIONS.
FOR DIMENSIONS : SEE DWG NO. B – 22
ALL DIMENSIONS ARE IN MILLIMETERS.
FOR STANDARD BAR DETAILS : SEE DWG NO. B – 28
MATERIAL (STRENGTH) PROPERTIES
CONCRETE :– THE MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS SHALL BE 20MPa (GRADE 20).
REINFORCEMENT STEEL :– THE MINIMUM YIELD STRENGTH OF DEFORMED BAR SHALL BE 500 MPA IN ACCORDANCE WITH ERA BRIDGE DESIGN MANUAL–2001
FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION
ALL BAR DIMENSIONS ARE OUT TO OUT
OVERLAP ø12, –300mm. ø16, –400mm. ø32, –1880mm.

BAR SCHEDULE





NOTE: THE SPLICING FOR BAR G'S SHALL BE VERTICALLY AS SHOWN BELOW
SPLICED BAR



NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

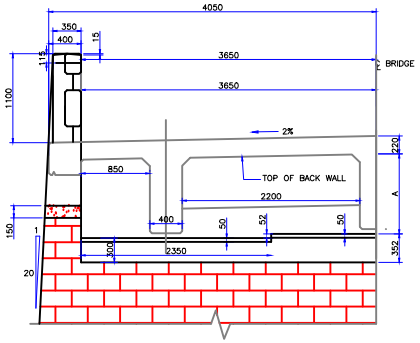
REVISIONS

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
ETHIOPIAN ROADS AUTHORITY
Post Office Box 1770 Addis Ababa Ethiopia
Cable Address Highways Addis Ababa
Telex 21180 Tel.No. 51–71–70/79

BRIDGE RC DECK GIRDER 16m. SPAN; WIDTH 4.5m.

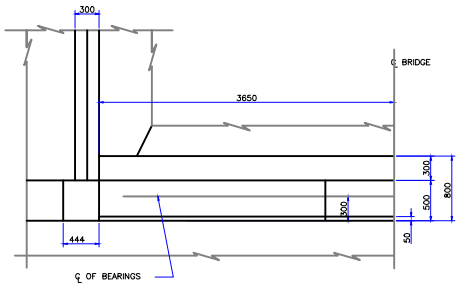
SHEET 2/2

DRAWN	SISAY GETU	SCALE:	DRG. NO.
DESIGNED	HENOK A.	AS SHOWN	B – 23
CHECKED	L. RAHM	DATE	
APPROVED	BEKELE JEBESSA	16/11/98	
EDITED	STEPHEN KIRSTEN		



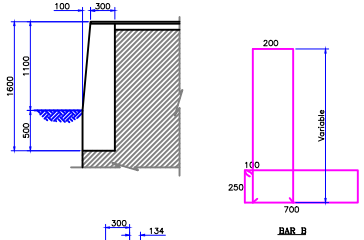
PART ELEVATION OF ABUTMENT

SCALE 1:30



PART PLAN OF ABUTMENT

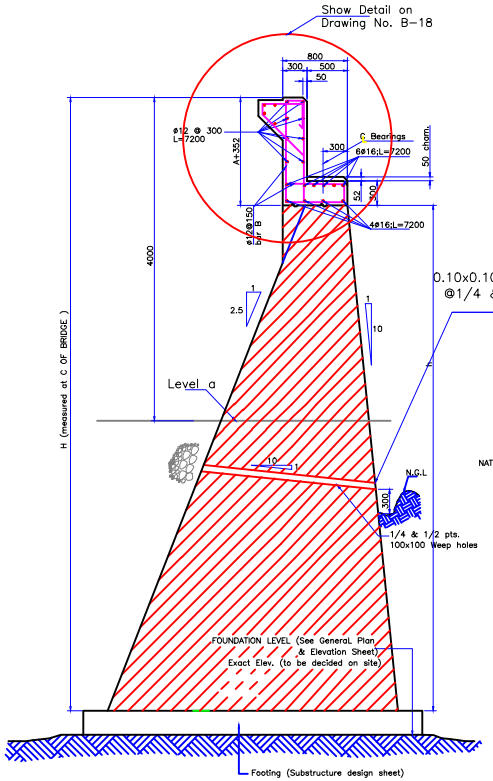
* INCLUDES BACK WALL



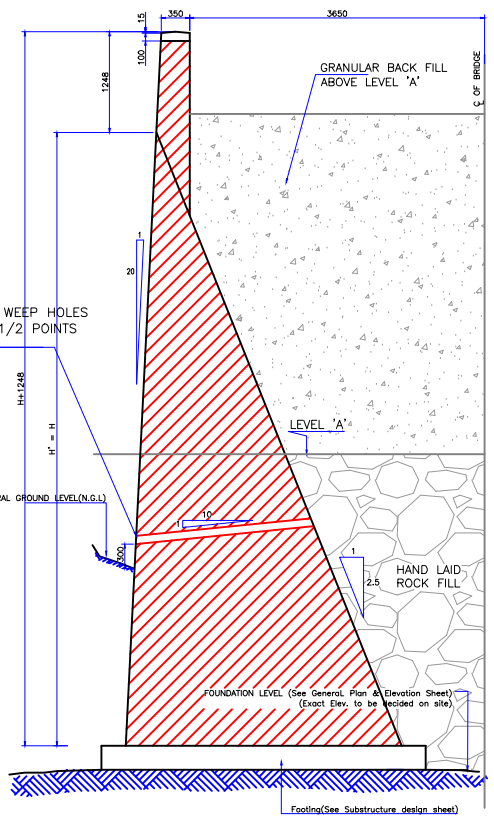
BAR B

DETAILS AT ENDS OF PARAPETS

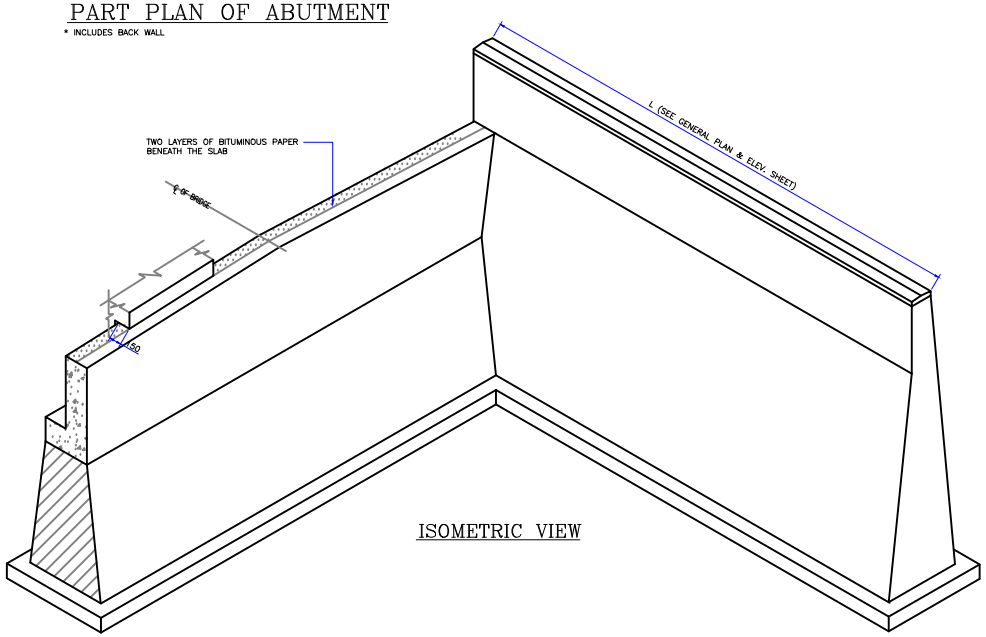
NOTES:
CAPPING, PARAPET ENDS, CORNER CAP STONES, ABUTMENT SEATS, FOOTING AND BACK WALLS SHALL BE CONCRETE AS SPECIFIED FOR MAIN CONS. OTHER MATERIAL TO BE CLASS "B" STONE MASONRY.



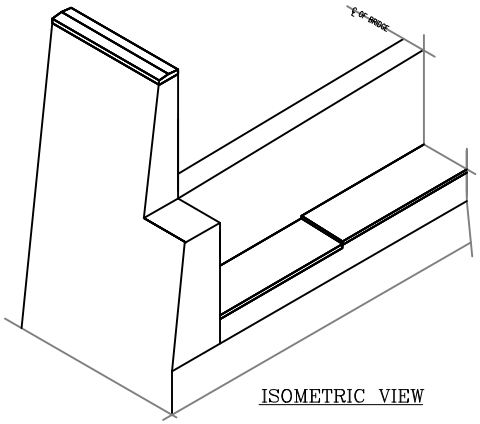
TYPICAL ABUTMENT SECTION



TYPICAL WING WALL SECTION



ISOMETRIC VIEW

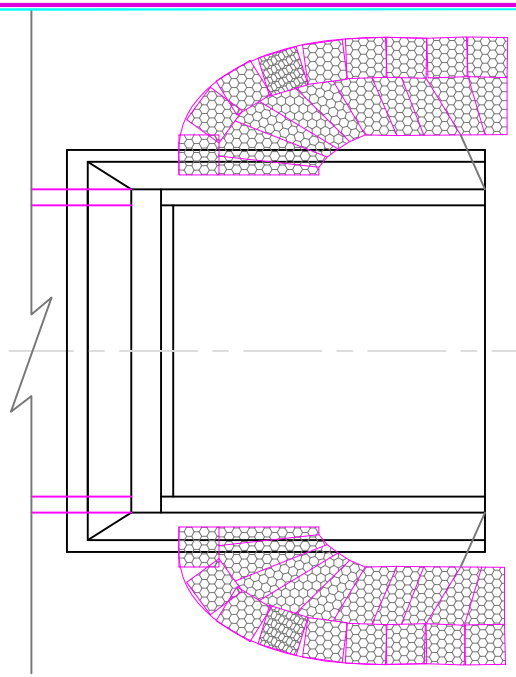


ISOMETRIC VIEW

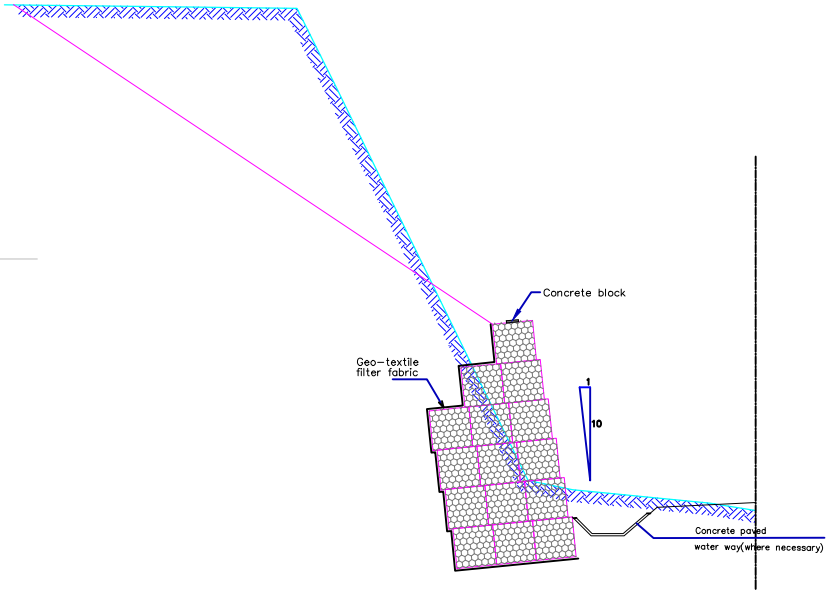
NOTE

- For heights greater than 4.0 m, backfield with hand laid rock fill upto level 'a'. The rock fill will be paid as hand laid rock embankment.
- All measurements are in millimeters.
- If an intact rock is found, the GRADE-5 concrete base may be omitted.
- Footing should be determined after geotechnical investigation is taken.

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA ETHIOPIAN ROADS AUTHORITY	REVISION DATE:	DRAWN BY: ADANECH T.	SCALE:	TITLE:
PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL STANDARD DRAWINGS	EDITED BY: STEPHEN KIRSTEN	DESIGNED BY: ASHENAFI L. / SAMUEL G. CHECKED BY: TESHOME W. / Mr. YOSHINORI OBATA APPROVED BY: BEKELE JEBESSA	Normal to Scale DATE: NOVEMBER, 2011	MASONRY ABUTMENT FOR THREE GIRDER SUPERSTRUCTURE DRAWING No.: B - 24

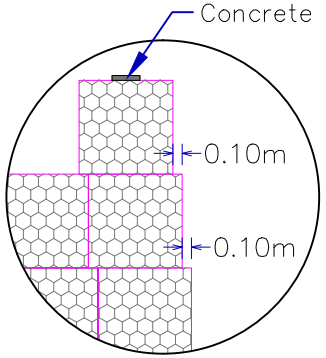


PLAN OF ABUTMENT

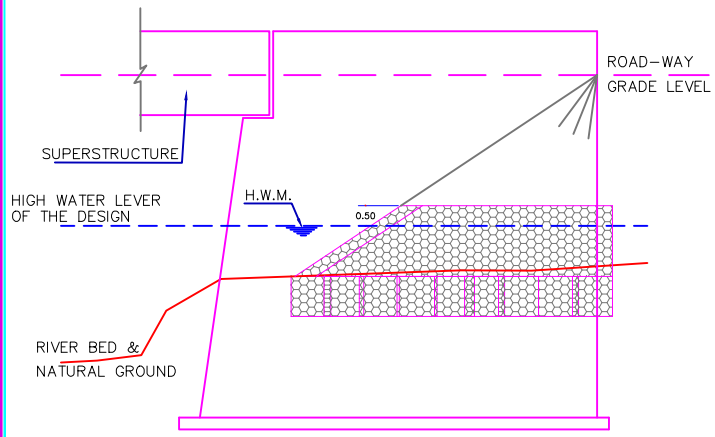


Typical Cross section of Gabion retaining wall

GABION RETAINING WALL

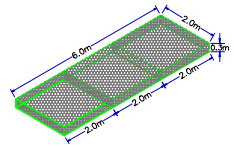


Concrete block (0.3mx0.3mx0.05m)



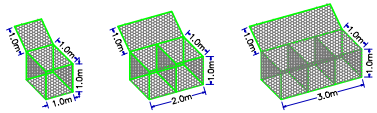
ELEVATION OF ABUTMENT

SCOUR PROTECTION OF WINGWALL



GABION MATTRESS

- Gabion mattress of 6X2X0.3



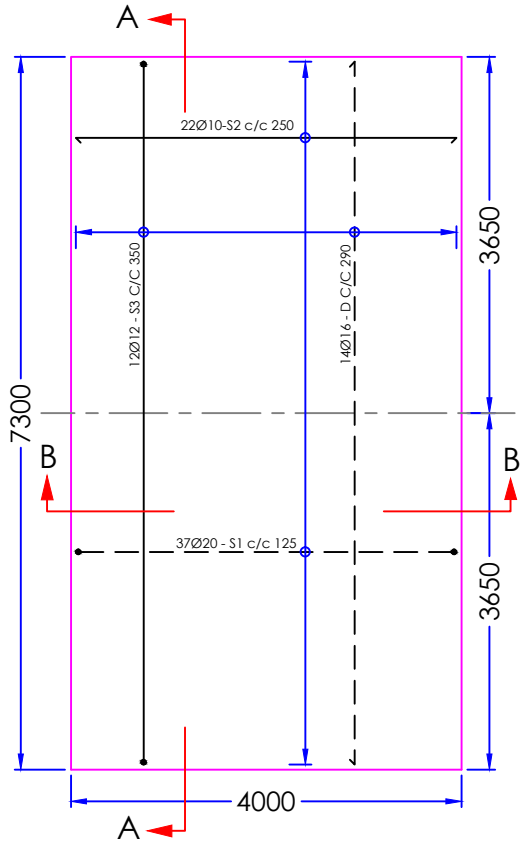
GABION BOXES

- Gabion boxes of 1X1X1 size
- Gabion boxes of 2X1X1 size shall have one partition
- Gabion boxes of 3X1X1 size shall have two partitions

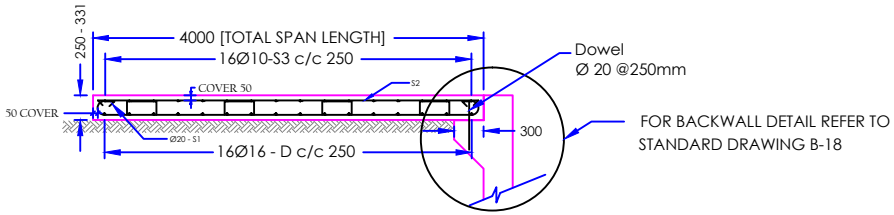
NOTE: -

- Material Type - PVC Coated Wire for under water part.
  - Galvanized wire for over water part.
- Specification of Material to be used: -
  - Minimum Wire diameter shall be 2.5mm for galvanized & 2.5mm diameter for PVC coated.
  - Wire mesh size shall be 80x100 mm for Boxes.
  - Wire mesh size shall be 60x80 mm for mattresses.
  - Yield strength of steel shall not be less than 350MPa.
- Minimum and maximum size of rock to be used are 15cm and 35cm respectively.
- Stone quality shall be clean, hard, sound, durable and not weathered boulders or rock fragments.
- Joints created between cages shall properly be staggered.
- Tie wire diameter shall be 2.0mm minimum.
- Selvage wire diameter shall be 3.0mm.
- Filter fabric shall be 100% first quality high tenacity white polypropylene. The geotextile shall be of the type non woven, assembled by needle punched treatment & thermo-calendared.
- Mass per unit area of the geotextile used shall be 120gm/m2 minimum.
- For additional information refer the ERA Technical Specification Series 9000 - Division 9100: GABIONS.

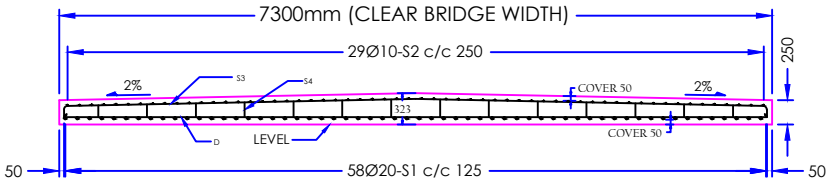
THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA ETHIOPIAN ROADS AUTHORITY	REVISION DATE:	DRAWN BY: ADANECH T.	SCALE:	TITLE:
PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL STANDARD DRAWINGS	EDITED BY: STEPHEN KIRSTEN	DESIGNED BY: ASHENAFI L. / SAMUEL G. CHECKED BY: TESHOME W. / YOSHINORI OBATA APPROVED BY: BEKELE JEBESSA	Normal to Scale DATE: NOVEMBER, 2011	GABION STRUCTURES DETAIL DRAWING No.:B-25



PLAN



LONGITUDINAL SECTION B-B



TYPICAL CROSS SECTION A-A

REINFORCING BAR SCHEDULE													
BAR	SIZE (mm)	NUMBER	BAR TYPE	DIMENSIONS (mm)					LENGTH (mm)	BAR c/c SPACING (mm)	TOTAL LENGTH (m)	TOTAL WEIGHT (kg)
				A	B	C	D	J				
S1	20	58	*	250	3900	-	-	160	4150	125	240.70	593.81
S2	10	29	Strt.	-	-	-	-	-	3900	250	113.10	69.78
S3	10	16	*	-	7200	160	160	-	7520	250	120.32	74.23
S4	12	49	*	-	-	-	-	-	800	1000	39.20	34.81
D	16	16	Strt.	-	-	-	-	-	7200	250	115.20	181.90
												954.53

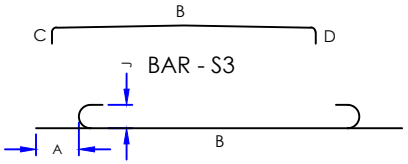
* See details on this sheet.

LEGEND:

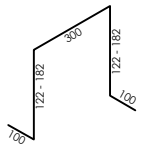
Top Reinf. (Straight bar)

Bottom Reinf. (Straight bar)

Hook or Bend at end.



BAR S1



BAR - S4
Ø12, Lav. = 0.80 m

CONCRETE ..... 8.366 m^3

REINFORCEMENT STEEL ..... 954.53 kg

GENERAL NOTES:

MANUALS USED:- THE PREVAILING VERSIONS OF THE ERA BRIDGE DESIGN MANUAL AND AASHTO LRFD Bridge Design Specification

LOADINGS USED:- HL-93 ACCORDING TO CHAPTER 3 OF THE ABOVE SPECIFICATIONS.

ALL DIMENSIONS ARE IN MILLIMETERS.

MATERIAL (STRENGTH) PROPERTIES:

CONCRETE:- THE MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS SHALL BE 24MPa (GRADE C30).

REINFORCEMENT STEEL:- THE MINIMUM YIELD STRENGTH OF DEFORMED BAR SHALL BE 400 MPa FOR BAR DIAMETER GREATER OR EQUAL TO 20mm AND 300MPa FOR BAR DIAMETER LESSTHAN 20mm.

FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION.

ALL BAR DIMENSIONS ARE OUT TO OUT.

OVERLAP:- Ø12 - 300mm, Ø16 - 400mm, Ø24-800mm

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
ETHIOPIAN ROADS AUTHORITY

PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL STANDARD DRAWINGS

REVISION

DATE:

EDITED BY: STEPHEN KIRSTEN

DRAWN BY: ADANECH T.

DESIGNED BY: ASHENAFI L. / SAMUEL G.

CHECKED BY: TESHOME W. / YOSHINORI OBATA

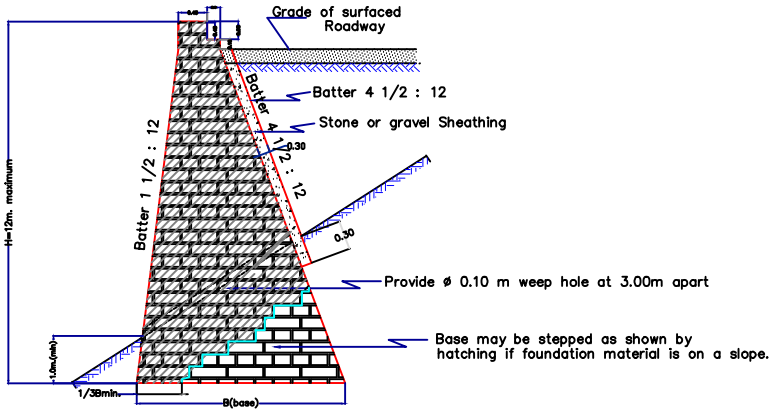
APPROVED BY: BEKELE JEBESSA

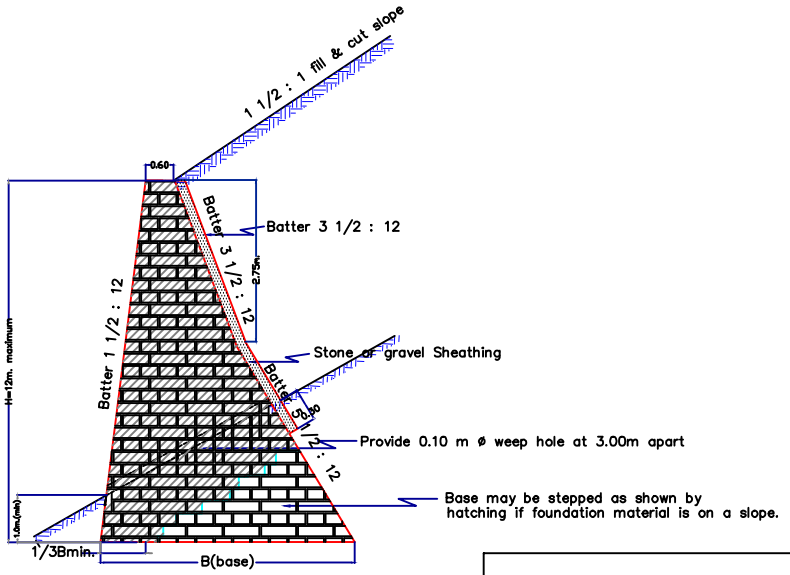
SCALE: Normal to Scale

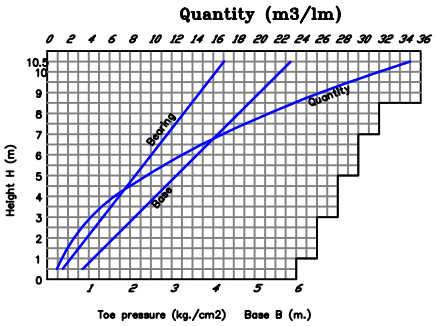
DATE: NOVEMBER, 2011

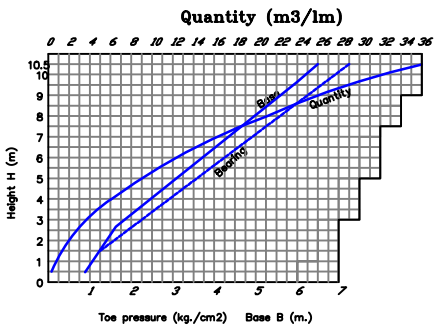
TITLE: 4.0m LONG RC APPROACH SLAB SUPERSTRUCTURE; WIDTH 8.10m.

DRAWING No.: B - 26


Grade of surfaced Roadway
Batter 4 1/2 : 12
Stone or gravel Sheathing
Batter 1 1/2 : 12
Batter 4 1/2 : 12
0.30
0.30
Provide ø 0.10 m weep hole at 3.00m apart
Base may be stepped as shown by hatching if foundation material is on a slope.
H=12m. maximum
1.0m.(min)
1/3Bmin.
B(base)


1 1/2 : 1 fill & cut slope
0.60
Batter 3 1/2 : 12
Batter 1 1/2 : 12
Batter 3 1/2 : 12
2.75m.
Stone or gravel Sheathing
Batter 3 1/2 : 12
0.30
Provide 0.10 m ø weep hole at 3.00m apart
Base may be stepped as shown by hatching if foundation material is on a slope.
H=12m. maximum
1.0m.(min)
1/3Bmin.
B(base)





TYPE A WALL

Design Data:– wt. of masonry = 2560 kg./m3
wt. of fill masonry = 1600 kg./m3
surcharge of 1.2meter at = 1600 kg./m3
fluid pressure of = 480kg./m3
curb and rail included in quantity

TYPE B WALL

Design Data:– wt. of masonry = 2560 kg./m3
wt. of fill masonry = 1600 kg./m3
surcharge slope = 1 1/2 : 1

GENERAL NOTE

(1) CONSTRUCTION SPECIFICATION specification for construction of Roads and Bridges on Federal Highway Projects and special provisions. See in particular Division 8900, stone masonry structures, and section 8100, for Exc. and back fill for structures.

(2) CLASS OF MASONRY:- class B unless otherwise specified.

(3) FOUNDATION MATERIAL :- foundation material shall be rock ,conglomerate, boulder formations, compact granular material or any combination thereof capable of safely carrying the toe pressure shown on the charts. If such material is not encountered at a reasonable depth below existing ground, the base width shall be increased to reduce the toe pressure to a safe value for the foundation material encountered. in all such cases, and in any case of doubt on the part of the Engineer, the matter shall be referred to the bridge division for field inspection and such design modifications as may be required.

(4) SUPPLEMENT CONSTRUCTION REQUIREMENTS:- All stones must be thoroughly wetted with water before placing. The top surfaces of masonry beds shall be kept free of mortar spillage, and wetted before placing mortar for the next bed of stones. All mortar shall be placed a trowel. Dumping of mortar on masonry beds from buckets or other containers shall not be permitted under any circumstances. The excessive use of stone fragments for filling voids shall not be permitted.

(5) COMPACT ION OF BACK FILL:- Back fill martial shall be mechanically compacted in horizontal layers not exceeding 15cm. in depth, to toe of walls. Material above toe of walls shall be compacted as specified for embankment.

(6) SAND SHEATHING:- Place 0.30m. filter layer, filter sand obtained from borrow pit , sheathing to 0.30m below weep holes. Material to conform to the details of this drawing and the specification.

(7) CLASS OF CONCRETE:- class C 20/20 with plumbs of stones unless otherwise specified.

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
ETHIOPIAN ROADS AUTHORITY

PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
STANDARD DRAWINGS

REVISION
DATE:

EDITED BY: STEPHEN KIRSTEN

DRAWN BY: ADANECH T.
DESIGNED BY: ASHENAFI L. / SAMUEL G.
CHECKED BY: TESHOME W. / YOSHINORI OBATA
APPROVED BY: BEKELE JEBESSA

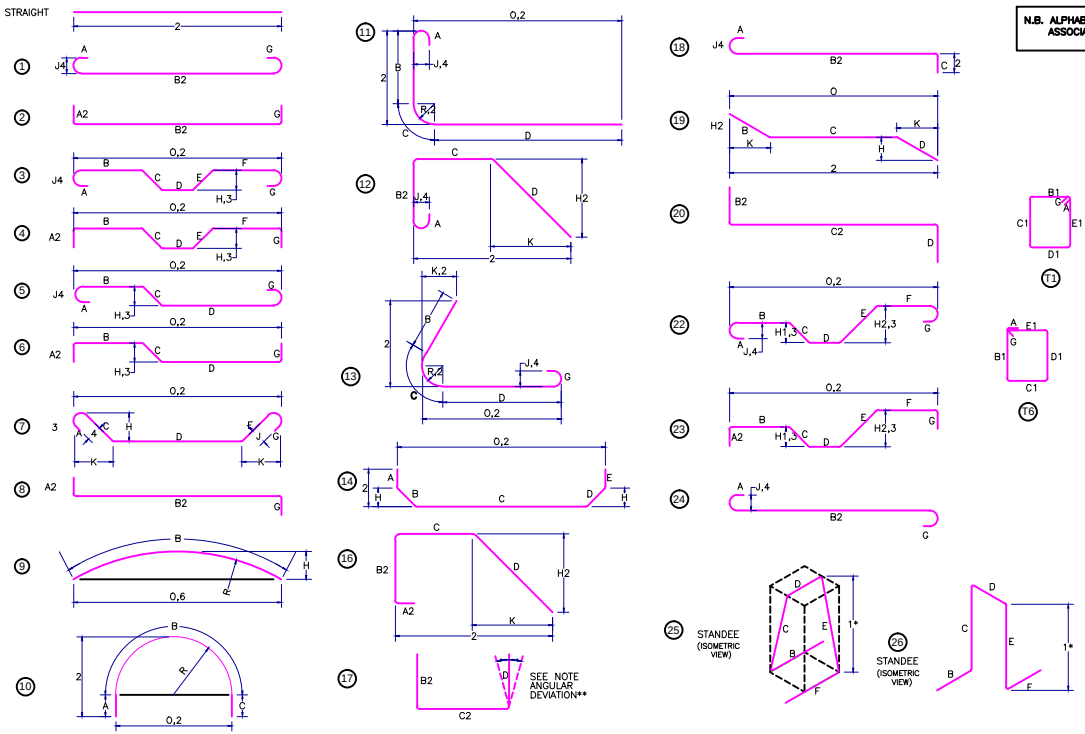
SCALE: NTSC

DATE: NOVEMBER, 2011

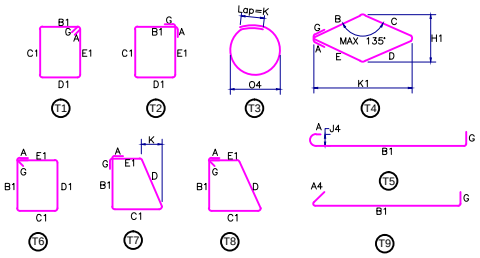
TITLE: MASONRY RETAINING WALL DETAIL

DRAWING No.: B - 27

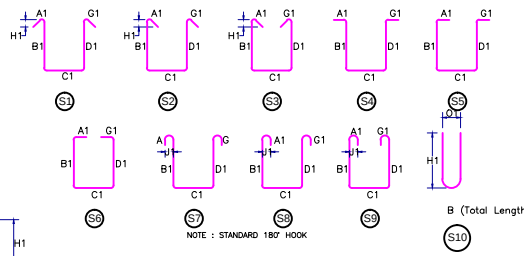
TYPICAL BAR BENDS


STRAIGHT
N.B. ALPHABETIC LETTERS ARE DIMENSIONS AND ASSOCIATED NUMBERS ARE TOLERANCE SYMBOLS.
SEE NOTE ANGULAR DEVIATION**
STANDEE (ISOMETRIC VIEW)
STANDEE (ISOMETRIC VIEW)

TIES



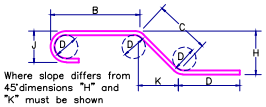
STIRRUPS & FABRICATING TOLERANCES



NOTES FOR BENDS:

1. All dimensions are out-to-out of bar except A or G on standard 180-deg and 135-deg hooks.
2. The J dimension on 180-deg hooks to be shown only when necessary to restrict hook size; otherwise standard hooks are to be used.
3. Where J is not shown, J will be kept equal to or less than H on truss bars. Where J can exceed H, it should be shown.
4. The H dimension on stirrups to be shown where necessary to fit within concrete.
5. Where bars are to be bent more accurately than standard bending tolerances, bending dimensions which require closer fabrication should have limits indicated.
6. Figures in circles show types.
7. For minimum bend diameters, see Table-3 of this standard; for recommended hook dimensions, see Table 1.
8. Types S1-S9,S11,T1-T9 apply to Bars #8-24 inclusive only.

   Unless otherwise noted diameter D is the same for all bends and hooks on a bar

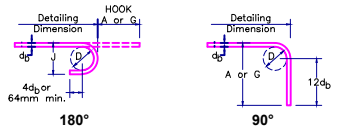


ENLARGED VIEW SHOWING BAR BENDING DETAILS

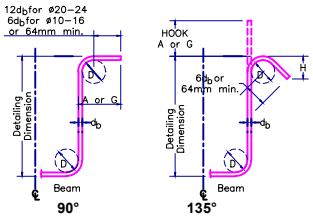
NOTES FOR DIMENSIONAL TOLERANCES:

- All tolerances are single plane and as shown.
- *Dimensions on this line are to be within tolerance shown but are not to differ from the opposite parallel dimension more than 12mm
- **Angular Deviation-maximum ±2.5° or 150mm, but not less than 12mm, on all 90° hooks and bends.
- If application of positive tolerance of Type 9 results in a chord length >_ the arc or bar length, the bar may be shipped straight.
- Tolerances for Types S1-S9, S11, T1-T9 apply to bar sizes #8-24 inclusive only.
- The standard fabricating tolerances are applicable for bar sizes #8-34.

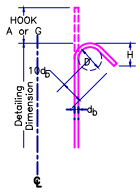
STANDARD HOOKS



STIRRUP AND TIE HOOKS



135° SEISMIC STIRRUP/TIE HOOKS



MINIMUM BEND DIAMETER TABLE-3

Bar Size and use [mm]	A or G [mm]
10-16 (General)	6.0d_b
8-16 (Stirrups & Ties)	4.0d_b
20-24 (General)	6.0d_b
30-36	8.0d_b
46-56	10.0d_b

NOTES

The inside diameter of bend for stirrups and ties in plain or deformed welded wire fabric shall not be less than 4.0d_b for deformed wire larger than #6, and 2.0d_b for all other wire sizes. Bends with inside diameters or less than 8.0d_b shall not be located less than 4.0d_b from the nearest welded intersection.

TABLE-1

RECOMMENDED END HOOKS, ALL GRADES

Bar size [mm]	Finished bend diameter "D" [mm]	180-deg hooks		90-deg hooks
		A or G [mm]	J [mm]	A or G [mm]
10	60	150	80	160
12	72	170	96	190
14	84	180	112	220
16	96	200	128	260
20	120	250	160	320
24	144	300	192	380
26	208	380	260	440
30	240	440	300	510
32	256	470	320	540

TABLE-2

Bar Size [mm]	D [mm]	Stirrup and tie hook dimensions			135 deg stirrup-tie hook dimensions	
		90-deg hook	135-deg hook		135-deg hook	
		A or G [mm]	A or G [mm]	H,approx. [mm]	A or G [mm]	H, approx. [mm]
8	32	80	90	60	100	70
10	40	90	90	60	130	90
12	48	110	110	70	150	100
14	56	130	120	80	180	120
16	64	140	140	90	210	140
18	108	290	180	110	260	160
20	120	320	200	120	280	180
24	144	380	250	150	340	210

TOLERANCE SYMBOLS

1 = ±12mm for bar sizes #8-16 [gross length<300mm]
1 = ±25mm for bar sizes #8-16 [gross length≥300mm]
1 = ±25mm for bar sizes #18-24
2 = ±25mm
3 = +0,-12mm
4 = ±12mm
5 = ±12mm for diameter≤760mm
5 = ±25mm for diameter>760mm
6 = ±1.5%*"O" dimension, ≥±50mm minimum

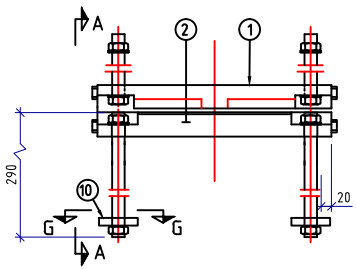
NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

REVISIONS

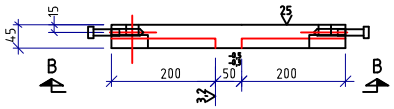
THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
ETHIOPIAN ROADS AUTHORITY
Post Office Box 1770 Addis Ababa Ethiopia
Cable Address Highways Addis Ababa
Telex 21180 Tel.No. 51-71-70/79

STANDARD BARS

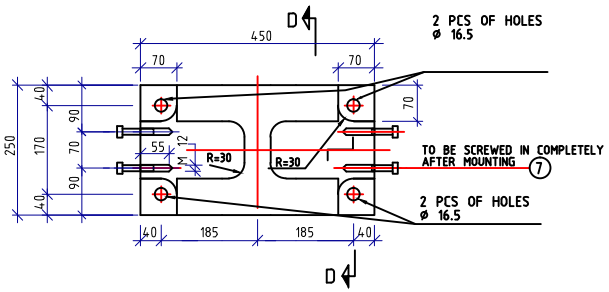
DRAWN	HENOK A.	SCALE:	DRG. NO.
DESIGNED	HENOK A.	AS SHOWN	B - 28
EDITED	STEPHEN KIRSTEN	DATE	
APPROVED	BEKELE JEBESSA	JULY 98	
APPROVED			



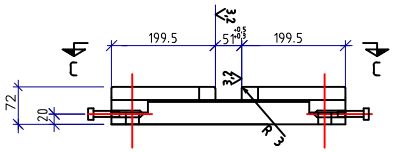
GENERAL ARRANGEMENT (SC. 1:5)



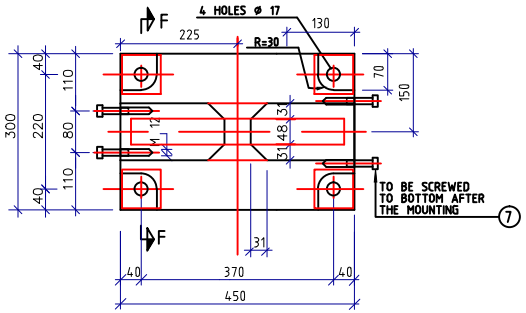
TOP PLATE (SC. 1:5)



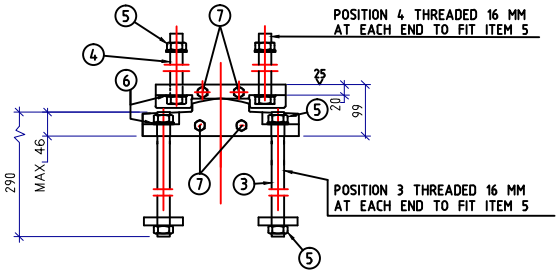
PLAN VIEW B-B (SC. 1:5)



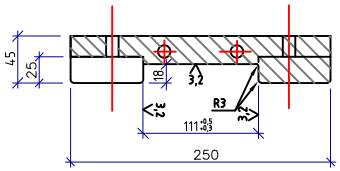
BOTTOM PLATE (SC. 1:5)



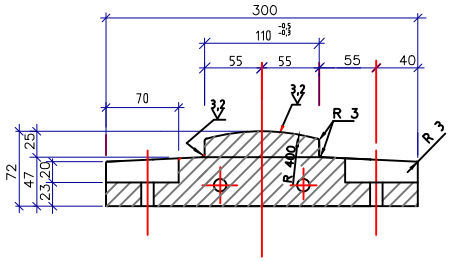
C-C (SC. 1:5)



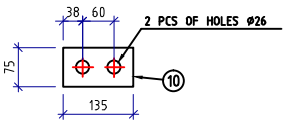
A-A (SC. 1:5)



D-D (SC. 1:2.5)



F — F (SC. 1:2.5)



G—G (SC. 1:5)

ITEM	NO.	NAME	LENGTH (MM)	MATERIAL	WEIGHT/EACH (KG)	NOTES
1	1	TOP PLATE	450	S355N	45	
2	1	BOTTOM PLATE	450	S355N	87	
3	12	BAR ø16	290	S355JO		HDZ
4	4	BAR ø16	200	5355		HDZ
5	20	NUT M16		10		HDZ
6	12	WASHER				HDZ
7	8	HAULING SCREW		8.8		HDZ
10	4	WASHER FLAT	135	S355J2G3	1	
THE LISTED ITEM REFERS TO ONE FIXED BEARING						
					TOTAL WEIGHT	143 KG/PCS

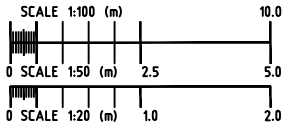
* HDZ=HOTDIP ZINC COATED

GENERAL NOTES

-CORROSION PROTECTION: TO BE MADE BEFORE ASSEMBLING THE PARTS. PREPARATION OF THE SURFACES BY ABRASIVE BLASTING OR BRUSHING TO A FINISH OF SA 2 1/2 OF THE SWEDISH STANDARD SIS 05 59 00. METAL SPRAYING OF THE SURFACES WITH ZINC TO COMPLY WITH THE REQUIREMENTS OF BS 2569 FOR Zn 10. COATING OF THE ZINC SPRAYED SURFACES WITHIN 4 HOURS WITH A SEALER COMPATIBLE WITH THE ZINC AND SUBSEQUENT COAT OF PAINT. APPLICATION OF TWO COATS OF 75 MICRON DRY FILM THICKNESS OF POLYAMIDE EPOXY PAINT.

-SURFACES TO BE EMBEDDED IN CONCRETE SHALL BE COATED AS ABOVE UP TO 30MM FROM THE EDGES.

-TOLERANCES ACCORDING TO BS "MEDIUM"



NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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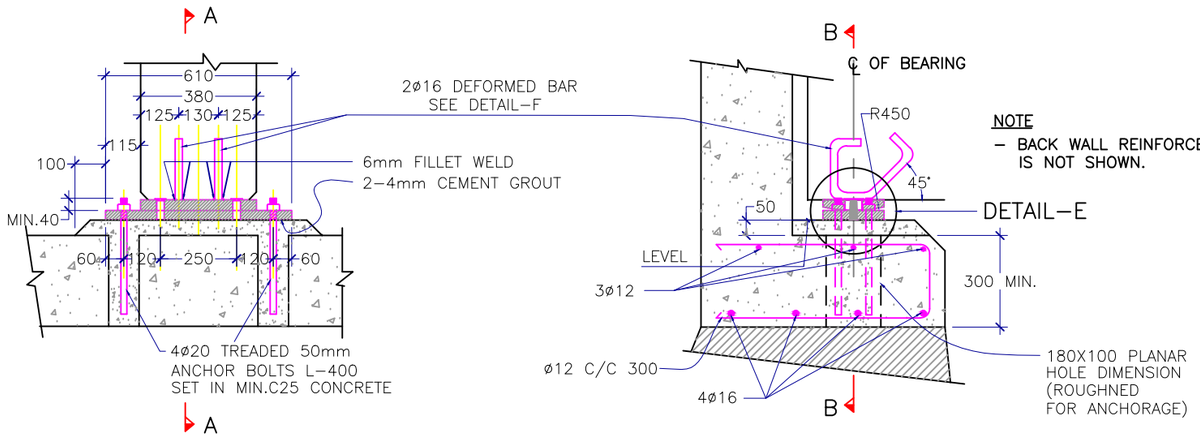
Telex 21180 Tel.No. 51-71-70/79

STEEL PLATE BEARING, FIXED 500-1000kN TYPE FPB1

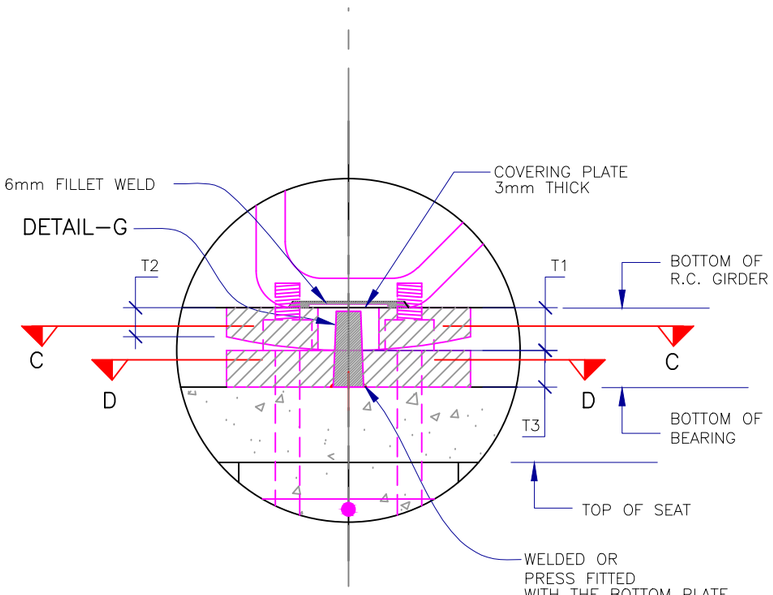
DRAWN	SISAY GETU	SCALE:	DRG. NO.
DESIGNED	L. RAHM	AS SHOWN	
CHECKED	L. RAHM	DATE	B - 29
APPROVED	BEKELE JEBESSA	03/12/98	
EDITED	STEPHEN KIRSTEN		



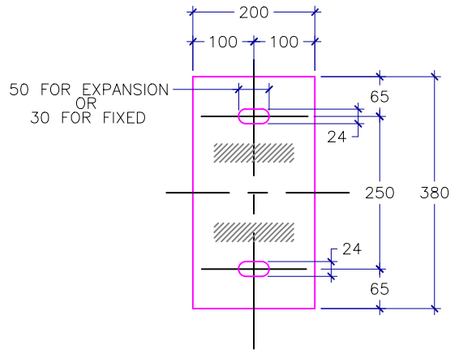
SECTION B–B SCALE 1:10

SECTION A–A SCALE 1:10

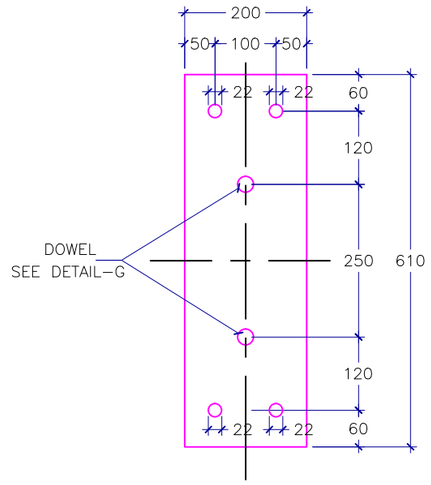
NOTE
– BACK WALL REINFORCEMENT IS NOT SHOWN.



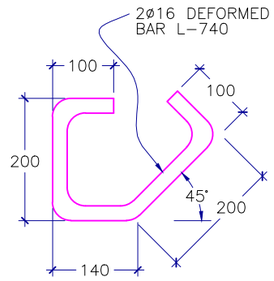
DETAIL–E SCALE 1:2.5



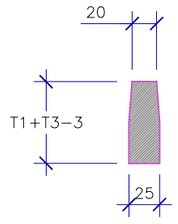
TOP PLATE
SECTION C–C SCALE 1:5



BOTTOM PLATE
SECTION D–D SCALE 1:5



DETAIL–F SCALE 1:5



PIN DETAIL
DETAIL–G SCALE 1:2.5

NOTE
- THE PLATES AND PINS SHALL HAVE A MINIMUM YIELD STRENGTH OF 300MPa.
- THE STAGES OF CONSTRUCTION IS AS FOLLOWS:
  * ABUTMENT SEAT IS CAST WITH THE HOLES FOR ANCHORING BOLTS
  * ANCHORING BOLTS ARE PLACED AND CONCRETE IN THE HOLES IS POURED.
  * FINALLY THE BOTTOM PLATE IS LEVELLED AND FIXED IN CEMENT GROUT.
- ALL DIMENSIONS ARE IN MILLIMETERS.

SUPERSTRUCTURE TYPE ERA STANDARD [R.C.D.G]		T1	T2	T3
C/C SPAN LENGTH [mm]	CLEAR BRIDGE WIDTH [mm]	[mm]	[mm]	[mm]
16600	4500–10000	35	24	30
14600	4500	35	24	30
14600	7320–10000	32	21	30
12600	4500	32	21	30
12600	7320–10000	30	19	30

LEGEND
- T1 –– TOP PLATE THICKNESS AT ℄ OF BEARING.
- T2 –– TOP PLATE END THICKNESS.
- T3 –– BOTTOM PLATE THICKNESS.

NOTE
- T3 MAY BE TAKEN EQUAL TO T1.

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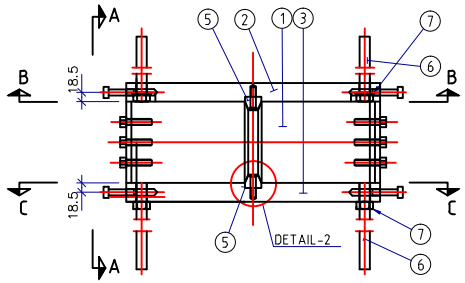
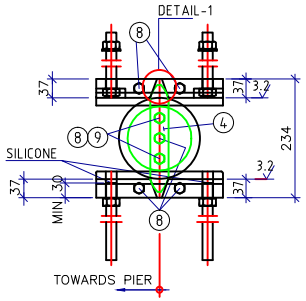
STEEL PLATE BEARING DETAIL FOR 12–16m SPAN R.C.D.G SUPERSTRUCTURES

DRAWN	HENOK A.	SCALE:	DRG. NO.
DESIGNED	HENOK A.	AS SHOWN	B – 30
CHECKED	L. RAHM	DATE	
APPROVED	BEKELE JEBESSA	MAR'99	
EDITED	STEPHEN KIRSTEN		



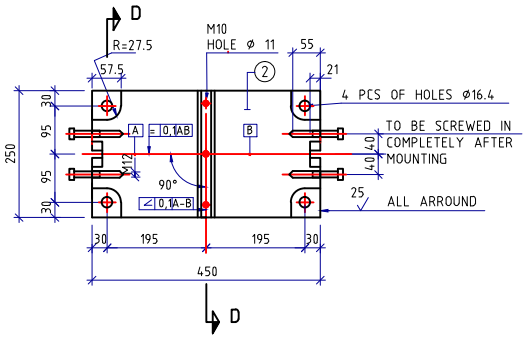
GENERAL ARRANGEMENT (SC. 1:5)



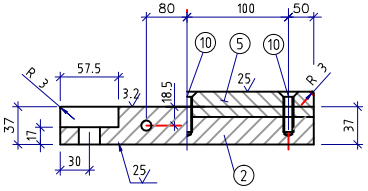
A-A (SC. 1:5)

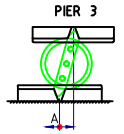
ITEM	NO.	NAME	LENGTH (MM)	MATERIAL	WEIGHT/EACH (KG)	NOTES
1	1	ROLLER	430	S460Q	69	
2	1	TOP PLATE	450	S460M	36	
3	1	BOTTOM PLATE	450	S460M	36	
4	2	GUIDE	211	S355	1	
5	2	GUIDE PLATE	250	S355	2	
6	8	ANCHOR SCREW ø16	130	S355		HDZ TREADED=60MM
7	8	NUT		8.8		HDZ
8	14	HAULING SCREW		8.8		HDZ
9	6	WASHER FLAT				ZINC COATED
10	6	ADJUSTMENT SCREW		4.8		
THE LIST CONSISTS OF ONE EXPANSION BEARING						
TOTAL WEIGHT: 145 KG/EACH						

* HDZ=HOTDIP ZINC COATED

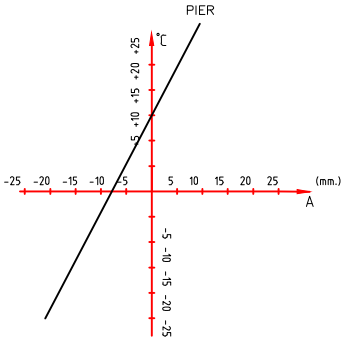


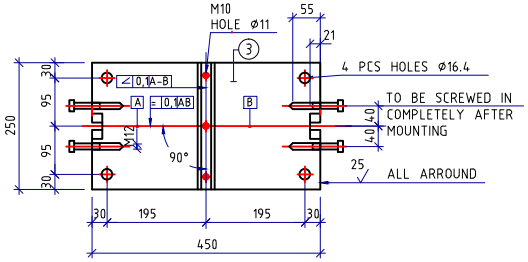
B-B TOP PLATE (SC. 1:5)



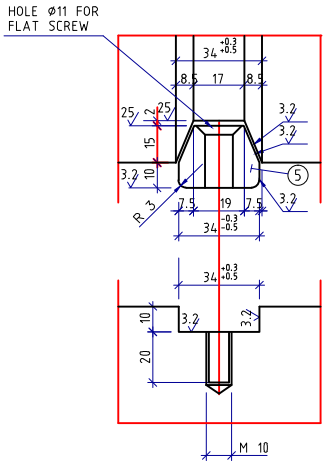


SETTING OF BEARING

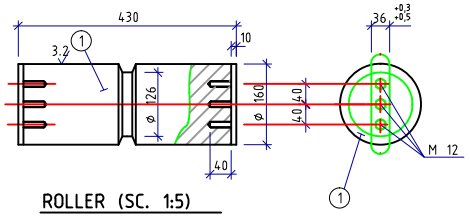




C-C BOTTOM PLATE (SC. 1:5)



DETAIL-2 (SC. 1:1)



ROLLER (SC. 1:5)

-TEMPERATURE SHOWN REFERS TO THE AVERAGE TEMPERATURE OF THE SUPERSTRUCTURE 24 HOURS BEFORE MOUNTING THE BEARING.

-WHEN MOUNTING THE BEARING THE BOTTOM PLATE SHALL BE HORIZONTAL AND THE TOP PLATE SHALL FIT THE BEAM/SUPERSTRUCTURE.

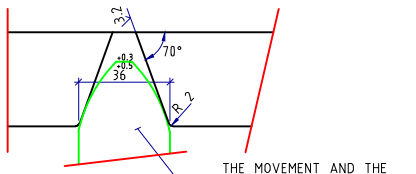
GENERAL NOTES

-CORROSION PROTECTION: TO BE MADE BEFORE ASSEMBLING THE PARTS. PREPARATION OF THE SURFACES BY ABRASIVE BLASTING OR BRUSHING TO A FINISH OF SA 2 1/2 OF THE SWEDISH STANDARD SIS 05 59 00. METAL SPRAYING OF THE SURFACES WITH ZINC TO COMPLY WITH THE REQUIREMENTS OF BS 2569 FOR Zn 10. COATING OF THE ZINC SPRAYED SURFACES WITHIN 4 HOURS WITH A SEALER COMPATIBLE WITH THE ZINC AND SUBSEQUENT COAT OF PAINT. APPLICATION OF TWO COATS OF 75 MICRON DRY FILM THICKNESS OF POLYAMIDE EPOXY PAINT.

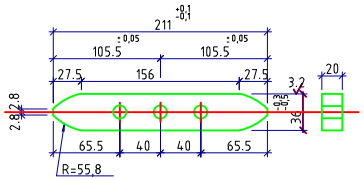
-SURFACES TO BE EMBEDDED IN CONCRETE SHALL BE COATED AS ABOVE UP TO 30MM FROM THE EDGES.

-TOLERANCES ACCORDING TO BS "MEDIUM"

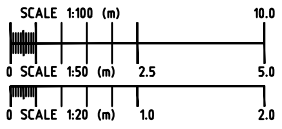
All dimensions are in mm.



DETAIL-1 (SC. 1:1)



GUIDE (SC. 1:2.5)
ITEM 4



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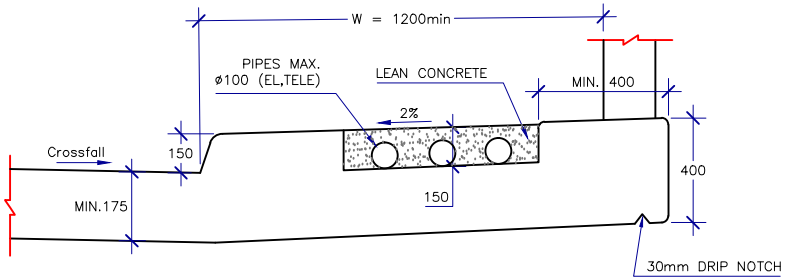
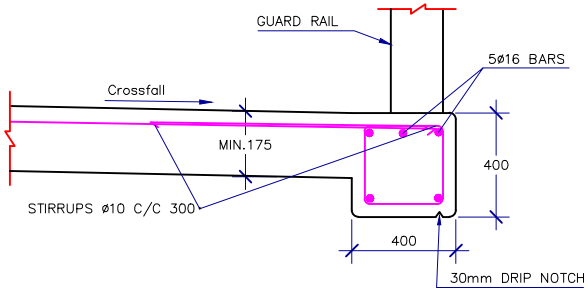
STEEL ROLLER BEARING, EXPANDABLE, 500-850kN. TYPE ERB2

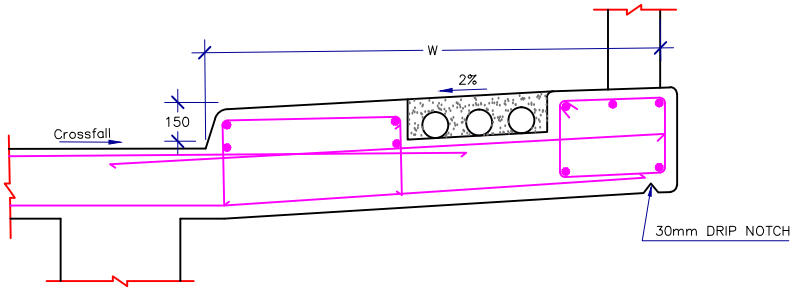
DRAWN	SISAY GETU	SCALE:	DRG. NO.
DESIGNED	L. RAHM	AS SHOWN	B – 31
CHECKED	L. RAHM	DATE	
APPROVED	BEKELE JEBESSA	5/02/99	
EDITED	STEPHEN KIRSTEN		



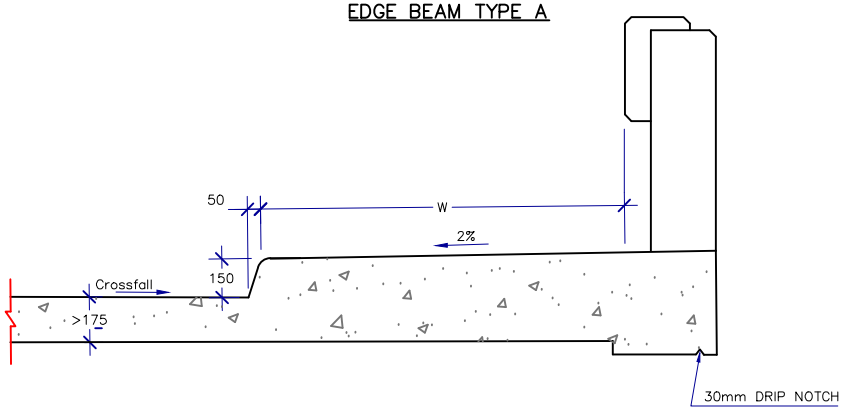
CURB TYPE A



EDGE BEAM TYPE A



CURB TYPE A REINFORCEMENT



CURB TYPE B

—

REINFORCEMENT : DEFORMED BARS WITH A MINIMUM YIELD OF 350 MPa.
IN ACCORDANCE WITH AASHTO/ETHIOPIAN STDS

NOTE

GUARD RAIL SEE DWG NO. B – 34
SCUPPER (DRAIN OUTLETS) B – 32
FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION

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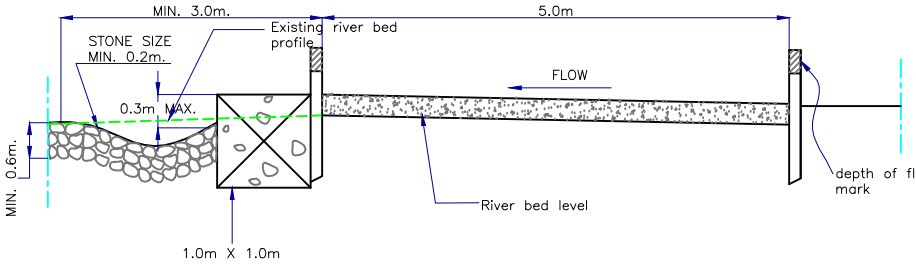
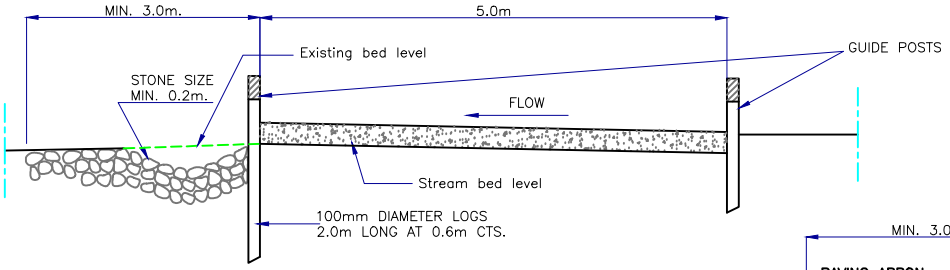
CURB STONES AND EDGE BEAMS

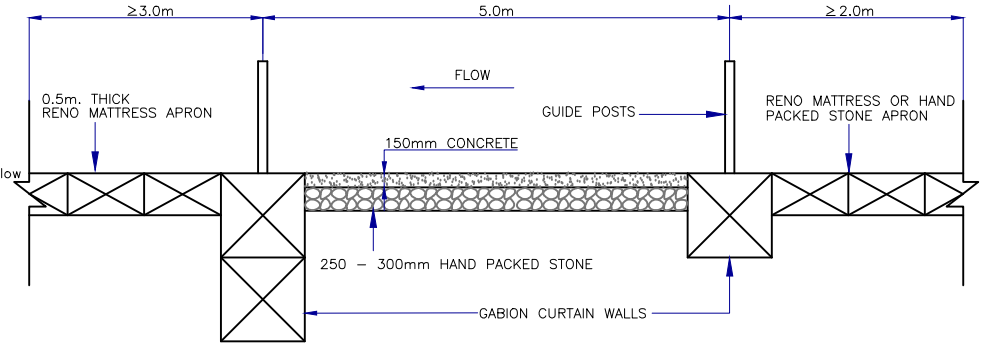
DRAWN	SISAY GETU	SCALE:	DRG. NO.
DESIGNED	L. RAHM	N.T.S	B – 35
CHECKED	L. RAHM	DATE	
APPROVED	BEKELE JEBESSA	02/16/99	
EDITED	STEPHEN KIRSTEN		



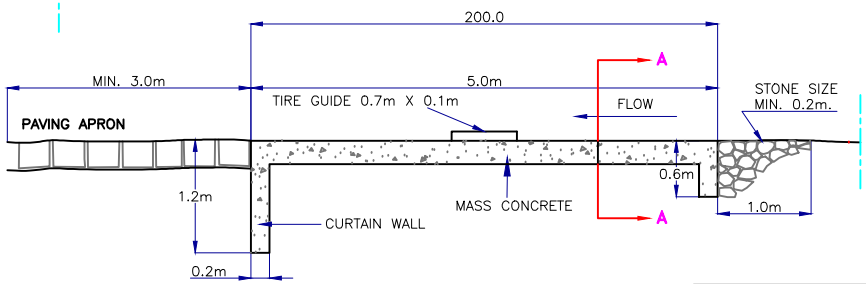
TYPE 1 FORD WITH DOWNSTREAM GABION



TYPE 2 FORD WITH TIMBER POST

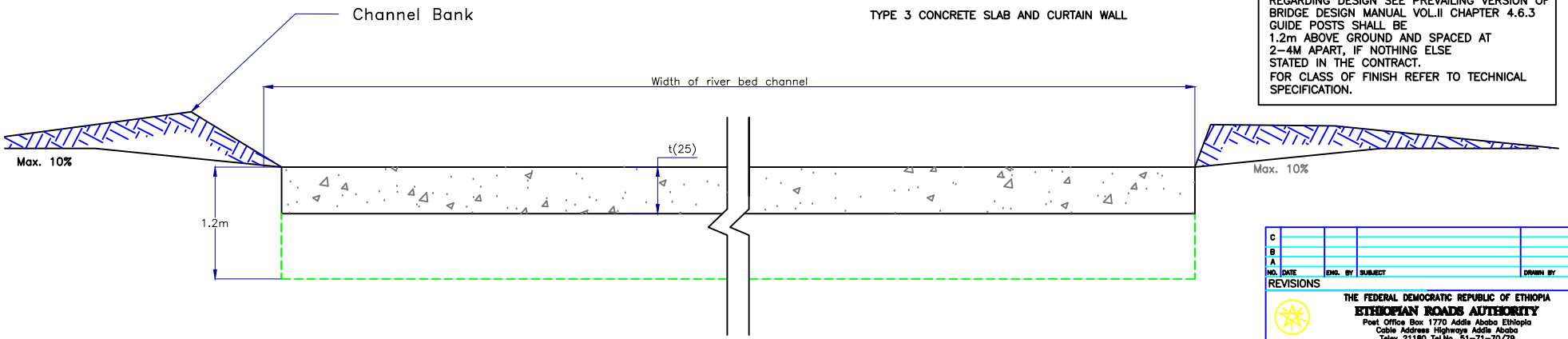


TYPE 4 CONCRETE SLAB AND FLEXIBLE BED PROTECTION



TYPE 3 CONCRETE SLAB AND CURTAIN WALL

NOTE
REGARDING DESIGN SEE PREVAILING VERSION OF BRIDGE DESIGN MANUAL VOL.II CHAPTER 4.6.3
GUIDE POSTS SHALL BE
1.2m ABOVE GROUND AND SPACED AT
2–4M APART, IF NOTHING ELSE
STATED IN THE CONTRACT.
FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION.



SECTION A–A

Longitudinal Section

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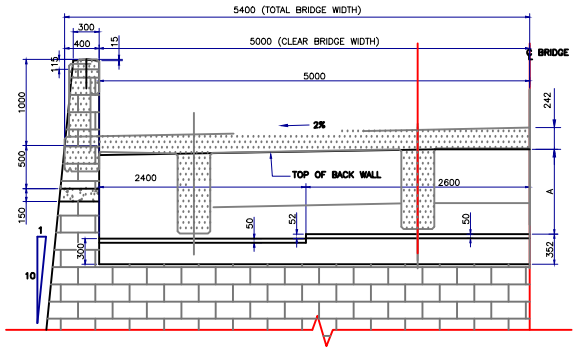
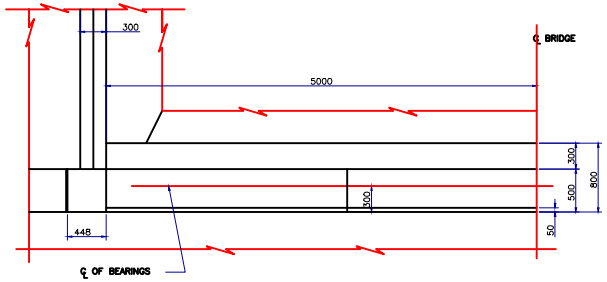
LOW LEVEL WATER CROSSING 5M WIDE

DRAWN	SABELA G.	SCALE:	DRG. NO.
DESIGNED	L. RAHM	1:25	B – 36
CHECKED	L. RAHM	DATE	
APPROVED	BEKELE JEMESSA	11/17/98	
EDITED	STEPHEN KIRSTEN		



PART ELEVATION OF ABUTMENT

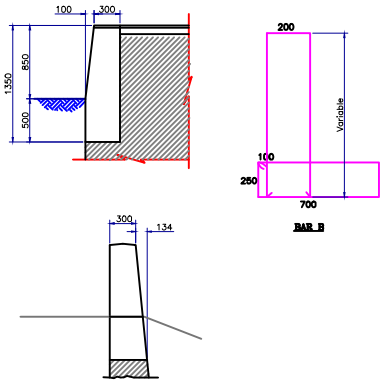
SCALE 1:30



PART PLAN OF ABUTMENT

* INCLUDES BACK WALL

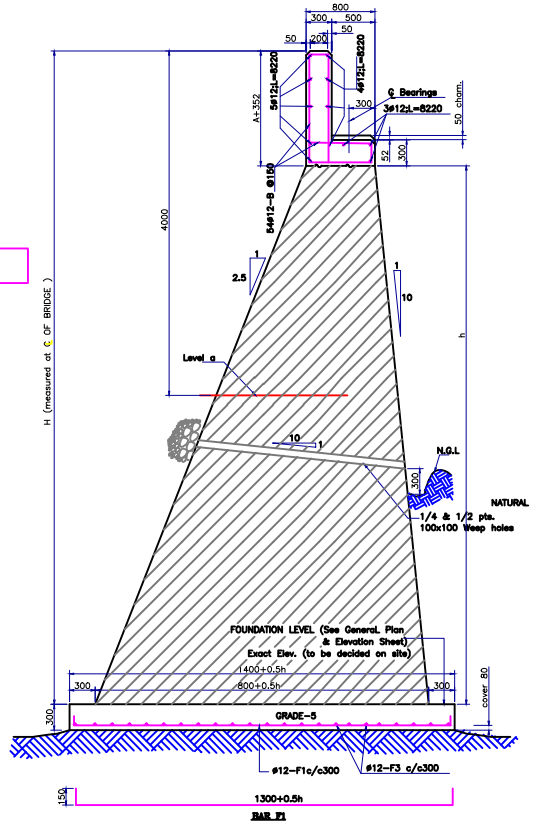
SCALE 1:30



DETAILS AT ENDS OF PARAPETS

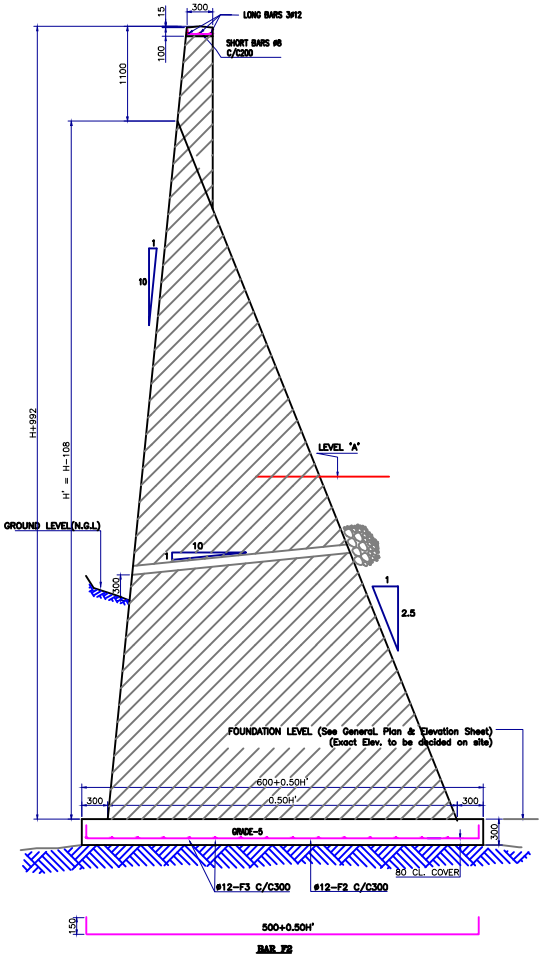
SCALE 1:30

NOTES:
CAPPING, PARAPET ENDS, CORNER CAP STONES, ABUTMENT SEATS, FOOTING AND BACK WALLS SHALL BE CONCRETE AS SPECIFIED FOR MAIN CONS. OTHER MATERIAL TO BE CLASS "B" STONE MASONRY.



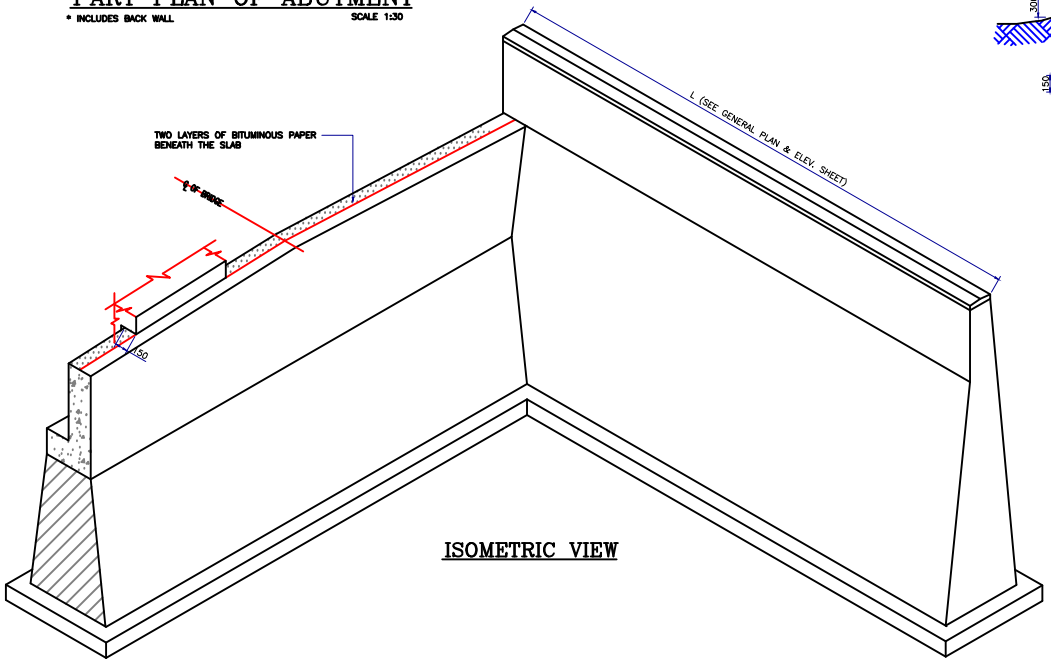
TYPICAL ABUTMENT SECTION

SCALE 1:30

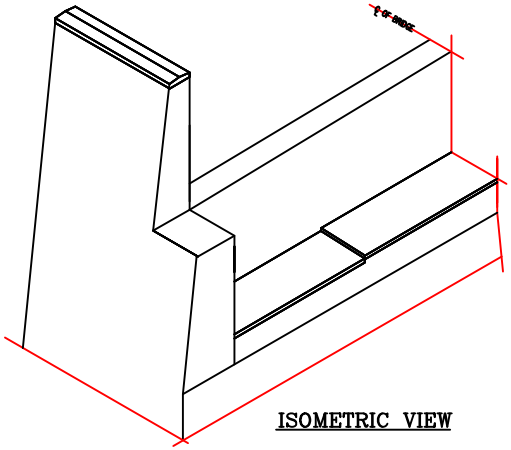


TYPICAL WING WALL SECTION

SCALE 1:30



ISOMETRIC VIEW



ISOMETRIC VIEW

NOTE

- For heights greater than 4.0 m, backfield with hand laid rock fill upto level 'a'. The rock fill will be paid as hand laid rock embankment.
- All measurements are in millimeters.
- The foundation material under abutments & w. walls shall be rock or with minimum allowable capacity of not less than 400kN/m^2 for heights less than or equal to 6m,and 500kN/m^2 for heights upto 9m.
- If an intact rock is found, the GRADE-5 concrete base may be omitted.

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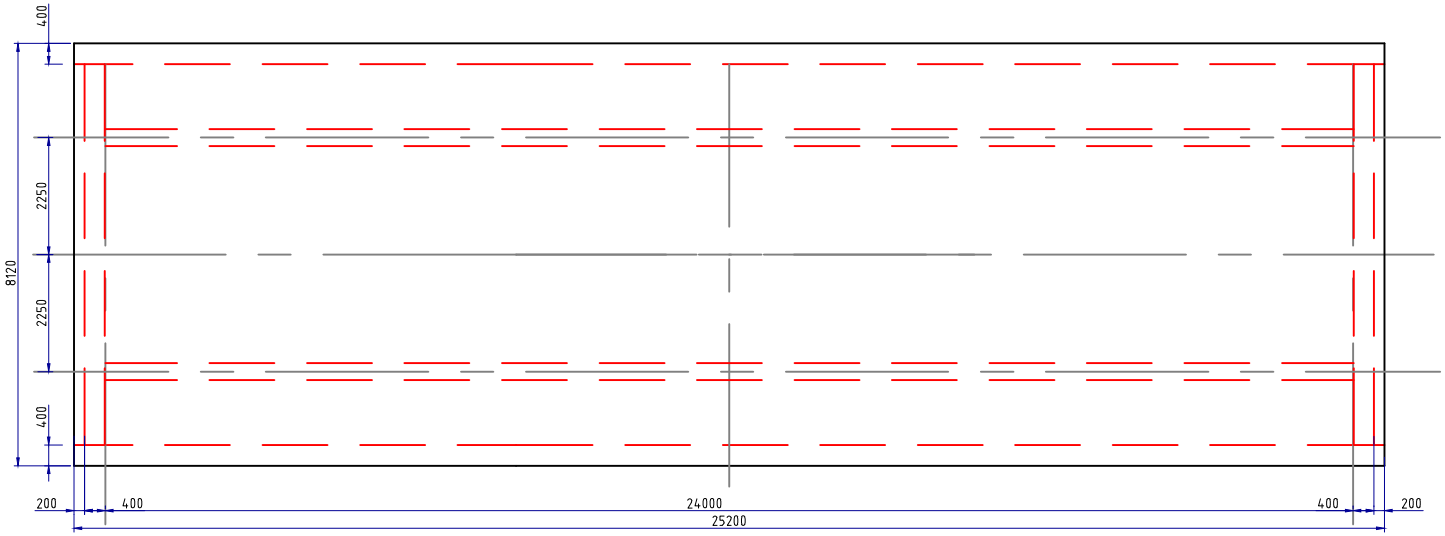
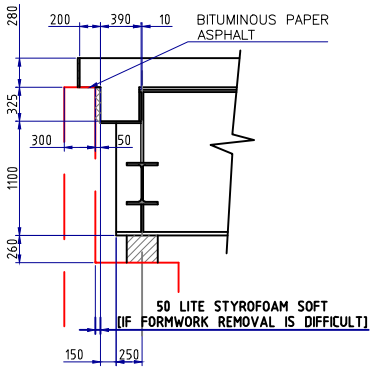
MASONRY ABUTMENT FOR FOUR GIRDER SUPERSTRUCTURES

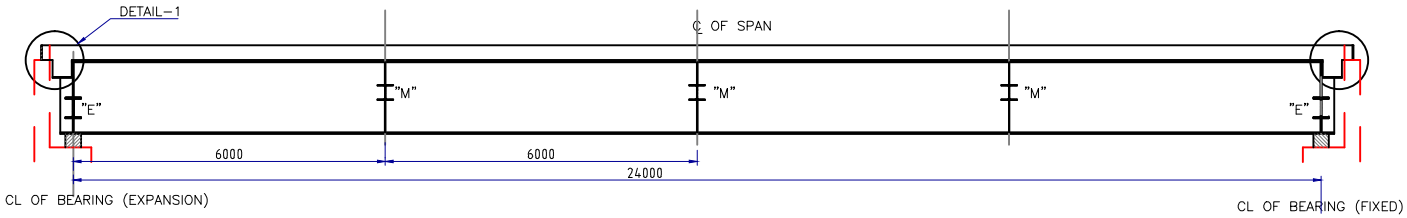
DRAWN	SISAY GETU	SCALE:	DRG. NO.
DESIGNED	HENOK A.	AS SHOWN	B – 37
CHECKED	L. RAHM	DATE	
APPROVED	BEKELE JEBESSA	JULY 1999	
EDITED	STEPHEN KIRSTEN		



PLAN (SCALE 1:50)



DETAIL–1 (SCALE 1:25)



LONGITUDINAL SECTION (SCALE 1:50)

GENERAL NOTES:

MANUALS USED : THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
LOADINGS USED : HL–93 SEE REINF. DWG ACCORDING TO CHAPTER 3 OF THE ABOVE SPECIFICATIONS.

FOR REINFORCEMENT : SEE DWG N° B–39
ALL DIMENSIONS ARE IN MILLIMETERS.

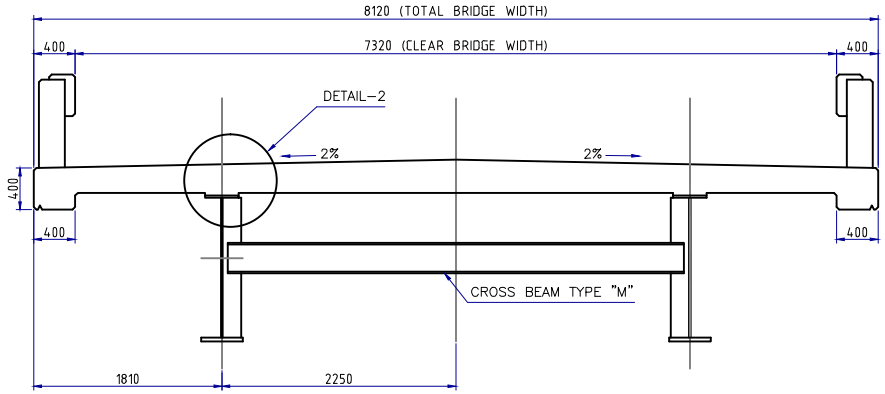
MATERIAL (STRENGTH) PROPERTIES

CONCRETE : THE MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS SHALL BE 20MPa (GRADE 20).

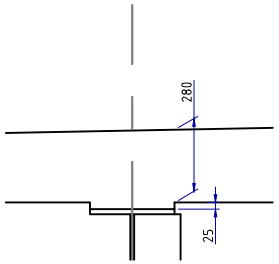
REINFORCEMENT STEEL: THE MINIMUM YIELD STRENGTH OF DEFORMED BAR SHALL BE 500 MPA IN ACCORDANCE WITH ERA BRIDGE DESIGN MANUAL–2001

FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION

STEEL: SEE DRAWING N° B–39



TYPICAL CROSS SECTION (SCALE 1:25)



DETAIL–2 (SCALE 1:10)

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

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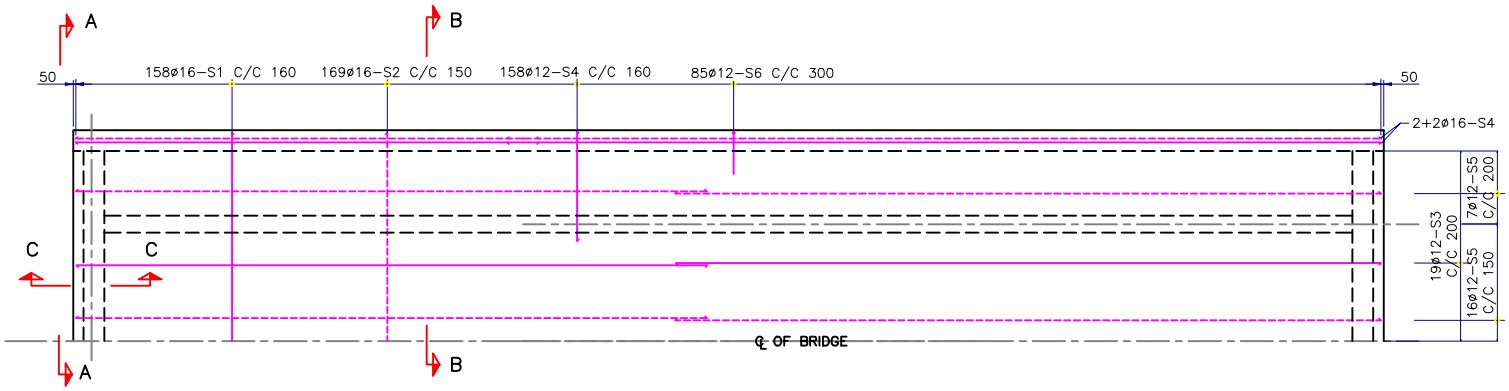
ETHIOPIAN ROADS AUTHORITY
Post Office Box 1770 Addis Ababa Ethiopia
Cable Address Highways Addis Ababa
Telex 21180 Tel.No. 51–71–70/79

COMPOSITE BRIDGE 24m. SPAN; WIDTH 7.3m

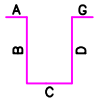
SHEET 1/4

DRAWN	A. RADING	SCALE:	DRG. NO.
DESIGNED	A. RADING	AS SHOWN	B – 38
CHECKED	L. RAHM	DATE	
APPROVED	BEKELE JEBESSA	20/12/99	
EDITED	STEPHEN KIRSTEN		

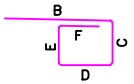


PLAN (SCALE 1:50)

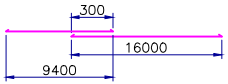
NOTE:
STRUCTURE DIMENSION AND REINFORCEMENT ARE SYMMETRICAL ABOUT C OF BRIDGE AND C OF SPAN



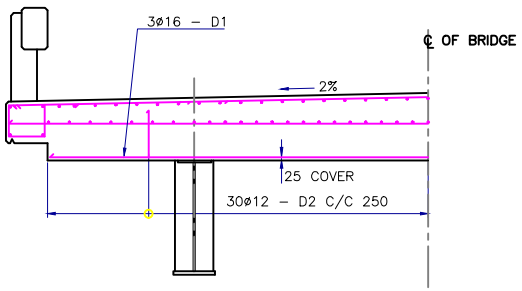
BAR–D2



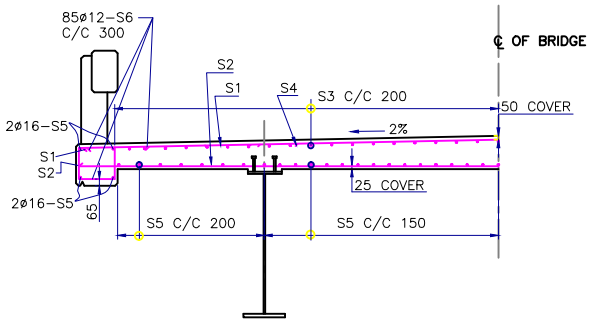
BAR–S6



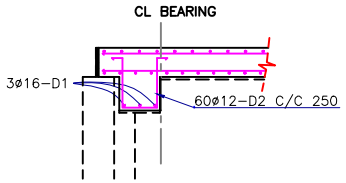
S3 & S5



END VIEW A–A (SCALE 1:25)



TYPICAL CROSS SECTION B–B (SCALE 1:25)



TYPICAL CROSS SECTION C–C (SCALE 1:25)

REINFORCING BAR SCHEDULE

BAR MARK	SIZE (mm)	NUMBER	BAR TYPE	DIMENSIONS (mm)								BAR LENGTH (mm)	TOTAL LENGTH (m)	TOTAL WEIGHT (Kg)
				A	B	C	D	E	F	G	J			
D1	16	6	Str.	–	–	–	–	–	–	–	–	5530	33.18	52
D2	12	60	*	100	475	340	475	–	–	100	–	1490	89.40	79
S1	16	158	Str.	–	–	–	–	–	–	–	–	8070	1275.06	2012
S2	16	169	Str.	–	–	–	–	–	–	–	–	8070	1363.83	2153
S3	12	37	Str.	–	–	–	–	–	–	–	–	25400	939.80	834
S4	12	316	Str.	–	–	–	–	–	–	–	–	2100	663.60	589
S5	12	45	Str.	–	–	–	–	–	–	–	–	25400	1143.00	1015
S6	12	170	*	–	750	280	350	280	200	–	–	1860	316.20	281

* See details this sheet
Str.---IMPLIES STRAIGHT BARS.

QUANTITIES
REINFORCEMENT: 7016 Kg.
CONCRETE: 63.14m^3

REINFORCEMENT SUMMARY			
BAR SIZE	12	16	32
TOT. Wt.	2798	4217	--
GROSS TOT. Wt.--7016 kg			

GENERAL NOTES:
MANUALS USED–THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
LOADINGS USED : HL–93 ACCORDING TO CHAPTER 3 OF THE ABOVE SPECIFICATIONS.
FOR DIMENSIONS : SEE DWG NO. B–38
FOR STANDARD BAR DETAILS : SEE DWG NO. B–28
PROVIDE 25mm CHAMFER AT ALL EDGES.
ALL DIMENSIONS ARE IN MILLIMETERS.

MATERIAL (STRENGTH) PROPERTIES
CONCRETE : THE MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS SHALL BE 20MPa (GRADE 20).
REINFORCEMENT STEEL: THE MINIMUM YIELD STRENGTH OF DEFORMED BAR SHALL BE 500 MPA IN ACCORDANCE WITH ERA BRIDGE DESIGN MANUAL–2001
ALL BAR DIMENSIONS ARE OUT TO OUT
OVERLAP ø12, – 300mm

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
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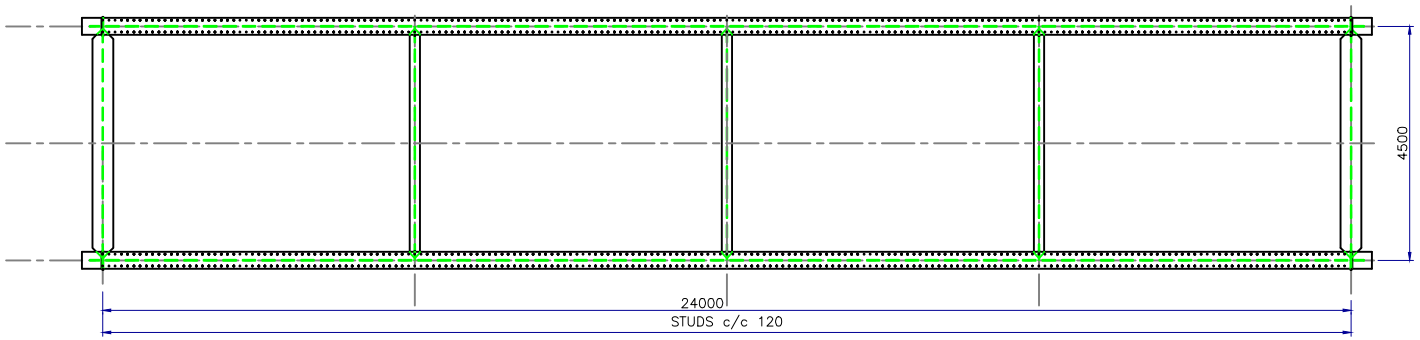
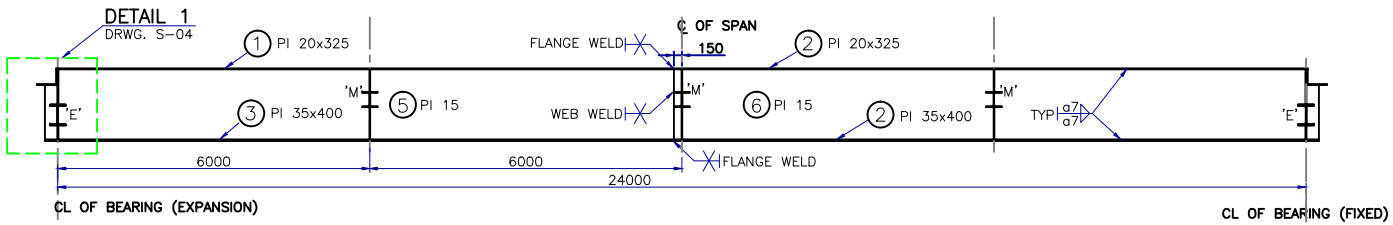
COMPOSITE BRIDGE 24m. SPAN;
WIDTH 7.3m.
SHEET 2/4

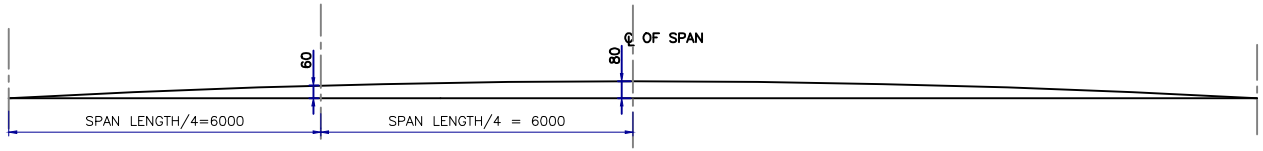
DRAWN	A RADING	SCALE:	AS SHOWN
DESIGNED	A RADING		
CHECKED	L. RAHM	DATE	20/12/99
APPROVED	BEKELE JEBESSA	DRG. NO.	B – 39
EDITED	STEPHEN KIRSTEN		



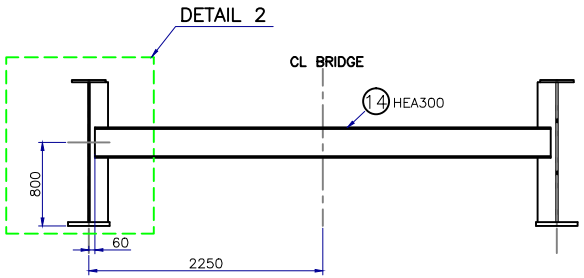
PLAN (SCALE 1:50)



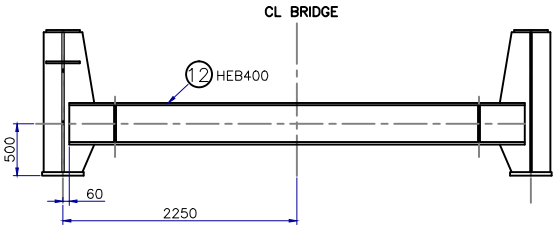
LONGITUDINAL SECTION (SCALE 1:50)



CAMBER FOR STEEL GIRDERS



CROSS BEAM TYPE 'M' (SCALE 1:25)



CROSS BEAM TYPE 'E' (SCALE 1:25)

GENERAL NOTES:

SPECIFICATIONS USED: SEE DRWG N° B-38

LOADINGS USED: SEE DRWG N° B-38

MATERIAL (STRENGTH) PROPERTIES

STUDS: TO BE MADE FROM COLD DRAWN BARS, GRADES 1015, 1018 OR 1020 EITHER SEMI- OR FULLY KILLED, COMFORMING TO AASHTO M169 (ASTM A108) - STANDARD SPECIFICATION FOR STEEL BARS, ETC

PLATES AND ROLLED PROFILES: SEE TABLE BELOW

GIRDERS, TOTAL 2 No's					
POS	No	ITEM	LENGTH	WEIGHT/ITEM	MATERIAL
1	1	UPPER FLANGE 20x325	11880	606 KG	S355
2	1	UPPER FLANGE 20x325	12180	621	S355
3	1	LOWER FLANGE 35x400	12100	1330	S355
4	1	LOWER FLANGE 35x400	12400	1363	S355
5	1	WEB 15x1345	12100	1916	S355
6	1	WEB 15x1345	12400	1963	S355
7	2	PL 20x325	390	20	S355
8	2	PL 20x178	1345	38	S355
9	2	PL 20x292	1345	61	S355
10	3	PL 15x178	1345	28	S355
11	402	STUDS ø20		0.37	
TOTAL WEIGTH/BEAM : 8270 KG					
CROSS BEAM TYPE 'E', TOTAL 2 No's					
12	1	HEB 400	4380	679 KG	S270
13	4	PL 15x130	352	5.4	S355
TOTAL WEIGHT/BEAM: 701 KG					
CROSS BEAM TYPE 'M', TOTAL No's 3					
14	1	HEA 300	4380	387 KG	S270
TOTAL WEIGTH/BEAM: 387 KG					

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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B					
A					

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COMPOSITE BRIDGE 24m. SPAN; WIDTH 7.3m

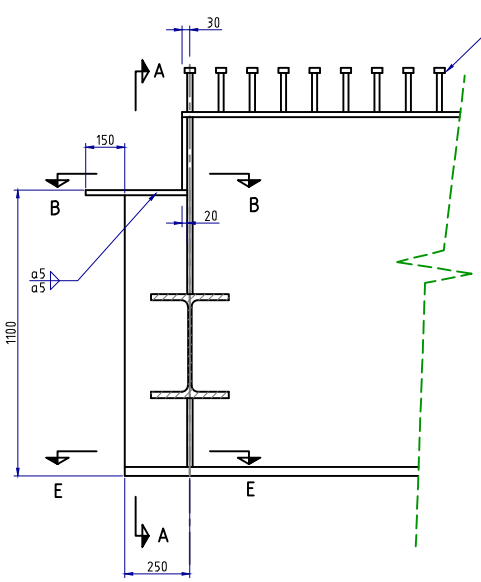
SHEET 3/4

DRAWN	A RADING
DESIGNED	A RADING
CHECKED	L RAHM
APPROVED	BEKELE JEBESSA
EDITED	STEPHEN KIRSTEN

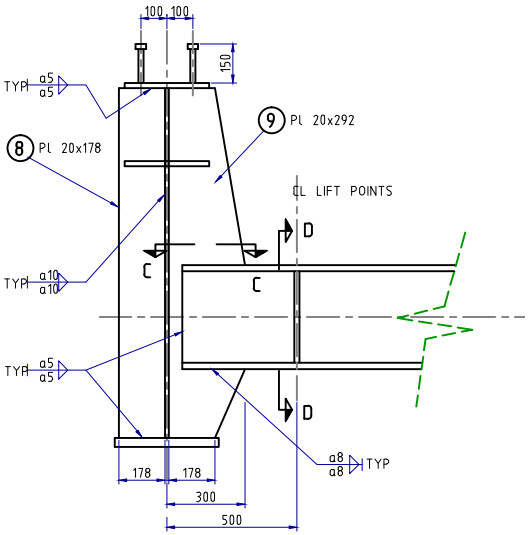
SCALE: AS SHOWN

DATE: 20/12/99

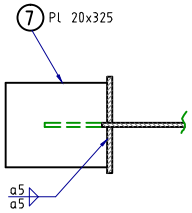
DRG. NO. B - 40



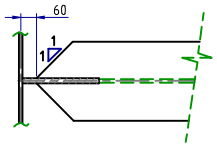
DETAIL 1 (SCALE 1:10)



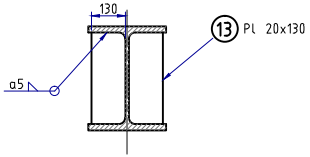
A-A (SCALE 1:10)



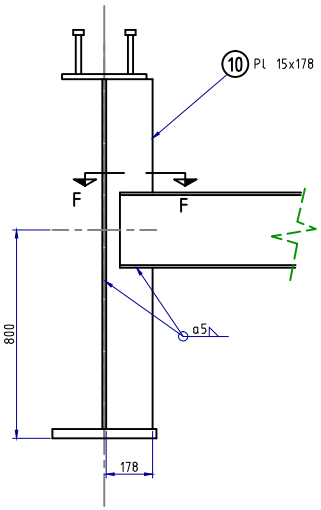
B-B (SCALE 1:10)



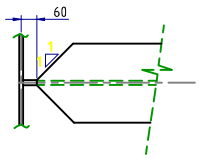
C-C (SCALE 1:10)



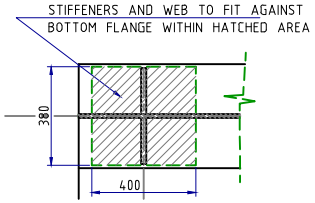
D-D (SCALE 1:10)



DETAIL 2 (SCALE 1:10)



F-F (SCALE 1:10)



E-E (SCALE 1:10)

GENERAL NOTES:
FOR GENERAL NOTES SEE DRWG N° B-38 AND N° B-40

MATERIAL (STRENGTH) PROPERTIES
FOR MATERIAL, SEE DRWG N° B-40

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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A					

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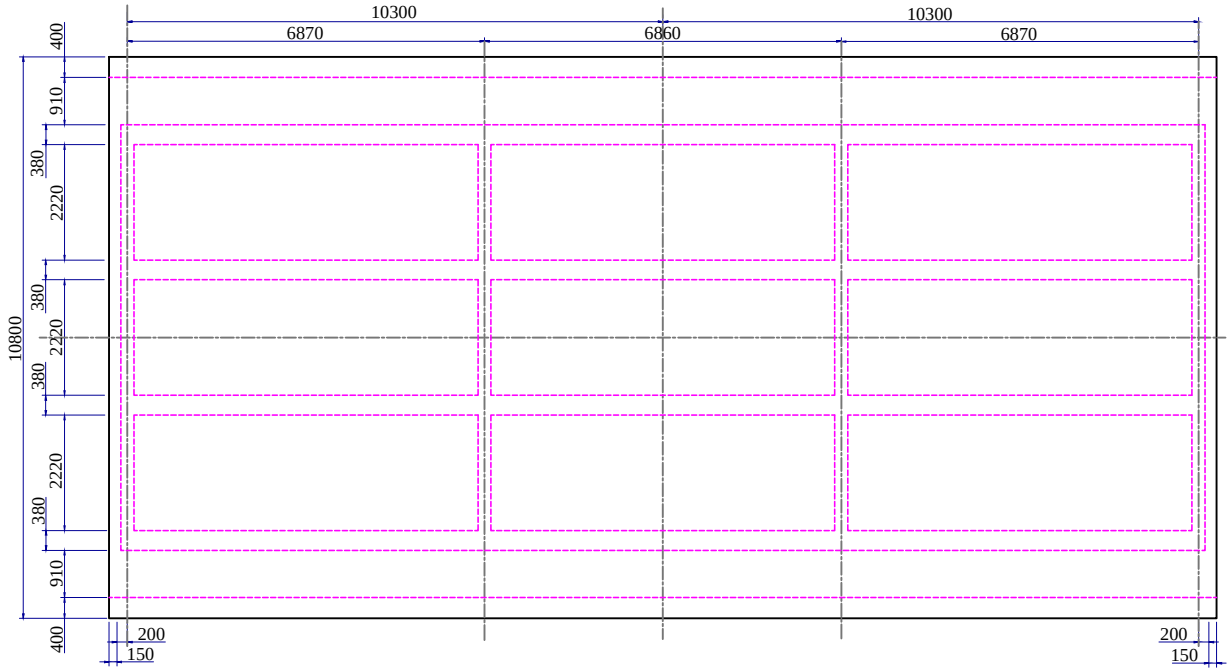
Telex 21180 Tel.No. 51-71-70/79

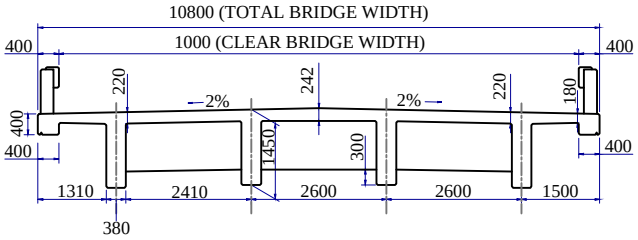
COMPOSITE BRIDGE 24m. SPAN;
WIDTH 7.3m

SHEET 4/4

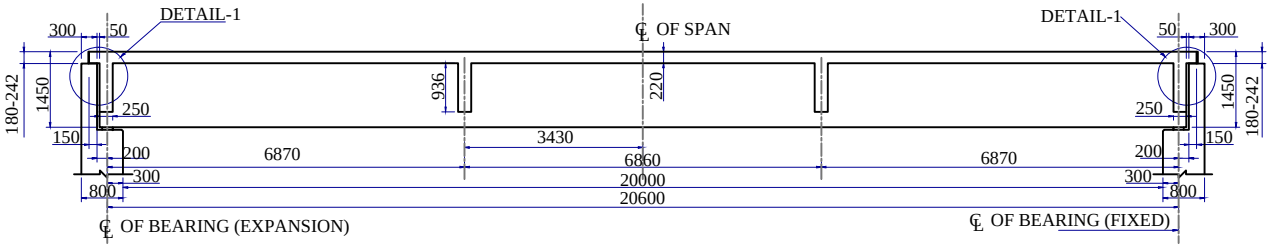
DRAWN	A RADING	SCALE: AS SHOWN	DRG. NO. B – 41
DESIGNED	A RADING		
CHECKED	L. RAHM		
APPROVED	BEKELE JEBESSA	DATE 20/12/99	
EDITED	STEPHEN KIRSTEN		



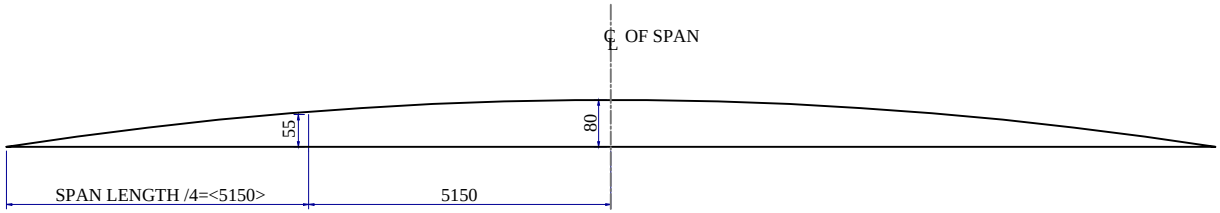
PLAN (SCALE 1:50)



TYPICAL CROSS SECTION (SCALE 1:50)



LONGITUDINAL SECTION (SCALE 1:50)



CAMBER TO BE PROVIDED BENEATH GIRDERS(SCALE Horiz. 1:50) Vert. 1:500

GENERAL NOTES

MANUAL USED: THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
LOADINGS USED:-HL-93 ACCORDING TO CHAPTER 3 OF THE ABOVE SPECIFICATIONS.

ALL DIMENSIONS ARE IN MILLIMETERS.

MATERIAL (STRENGTH) PROPERTIES

CONCRETE :- THE MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS SHALL BE 20MPa (GRADE 20).

REINFORCEMENT STEEL- THE MINIMUM YIELD STRENGTH OF DEFORMED BAR SHALL BE 500 MPa IN ACCORDANCE WITH THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL

FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION

SIDE WALKS

IF SIDE WALKS ARE REQUIRED REFER TO DRAWING B-35 FOR EDGE BEARINGS

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

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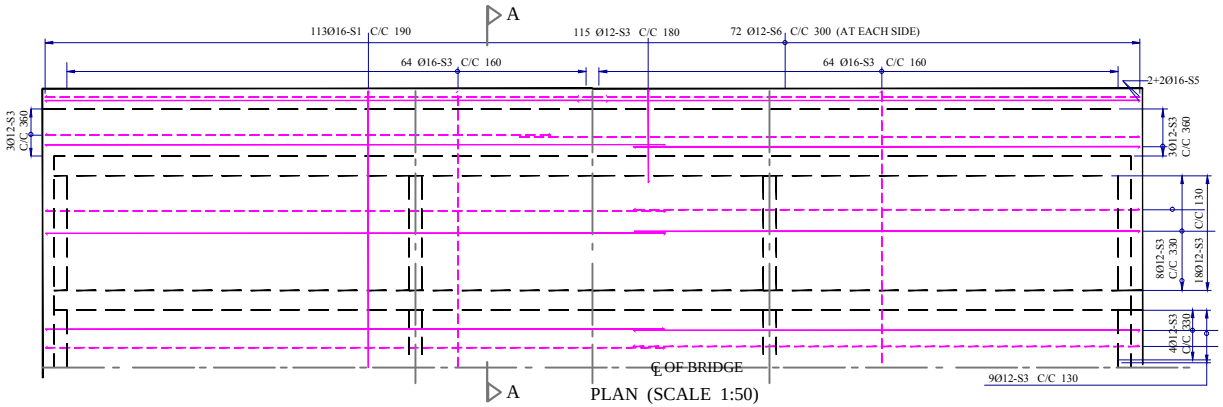
Cable Address :Highways Addis Ababa
Telex 21180 Tel.No. 51-71-70/79

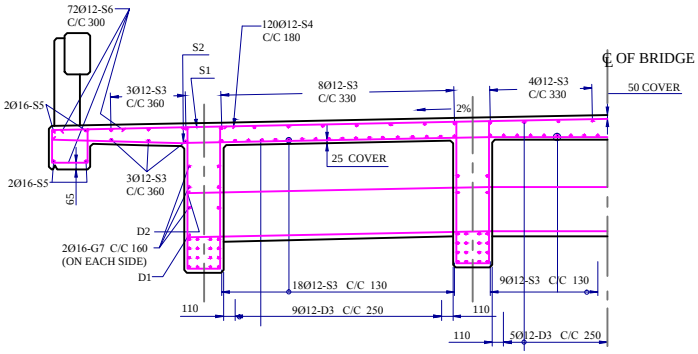
BRIDGE RC DECK GIRDER 20m. SPAN; WIDTH 10m.

SHEET 1/2

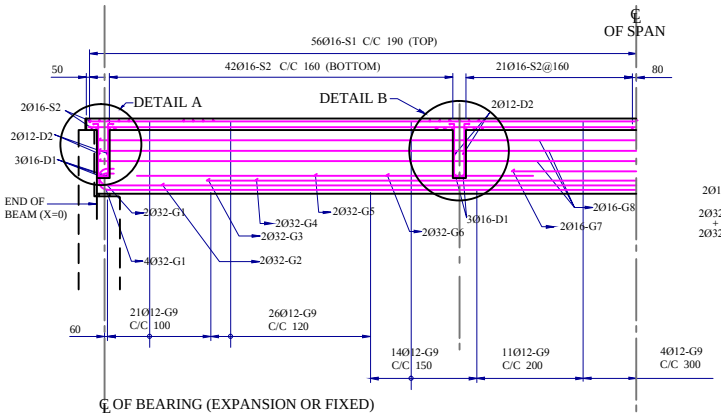
DRAWN	SISAY GETU	SCALE:	DRG. NO.
DESIGNED	HENOK A.	AS SHOWN	
CHECKED	L. RAHIM	DATE	B – 42
APPROVED	BEKELE JEBESSA	16/11/98	
EDITED	STEPHEN KIRSTEN		



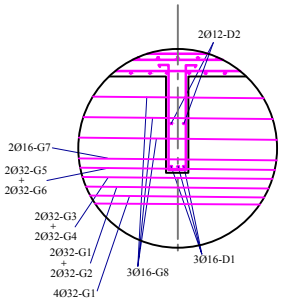
PLAN (SCALE 1:50)



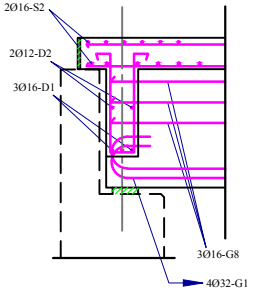
TYPICAL CROSS SECTION A - A (SCALE 1:25)



LONGITUDINAL SECTION (SCALE 1:50)



DETAIL B (SCALE 1:25)



DETAIL A (SCALE 1:25)

REINFORCING BAR SCHEDULE

BAR MARK	SIZE (mm)	NUMBER	BAR TYPE	DIMENSIONS (mm) A	B	C	D	E	F	G	J	BAR LENGTH (mm)	TOTAL LENGTH (m)	TOTAL WEIGHT (Kg)
D1	16	12	Str.	-	-	-	-	-	-	-	-	8130	97.56	116
D2	12	8	Str.	-	-	-	-	-	-	-	-	8130	65.04	43
D3	12	108	*	100	1000	200	1000	-	-	100	-	2400	259.20	173
G1	32	24	*	716	6335	12000	213	-	-	-	160	26101	627	3959
G2	32	8	Str.	-	-	-	-	-	-	-	-	18407	147.26	930
G3	32	8	Str.	-	-	-	-	-	-	-	-	16637	133.10	840
G4	32	8	Str.	-	-	-	-	-	-	-	-	14763	118.10	746
G5	32	8	Str.	-	-	-	-	-	-	-	-	12479	99.83	630
G6	32	8	Str.	-	-	-	-	-	-	-	-	9693	77.54	490
G7	16	8	Str.	-	-	-	-	-	-	-	-	4832	38.66	61
G8	16	24	Str.	-	-	-	-	-	-	-	-	21200	508.8	803
G9	12	608	*	100	1360	300	1360	-	-	100	-	3220	1957.76	1738
S1	16	113	Str.	-	-	-	-	-	-	-	-	10750	1214.8	1917
S2	16	128	Str.	-	-	-	-	-	-	-	-	10750	1376	2172
S3	12	90	Str.	-	-	-	-	-	-	-	-	21500	1935	1718
S4	12	115	Str.	-	-	-	-	-	-	-	-	1795	215.4	191
S5	16	8	Str.	-	-	-	-	-	-	-	-	21800	172.8	273
S6	12	144	*	-	750	280	350	280	200	-	-	1860	267.8	238

* See details this sheet
Str. ---IMPLIES STRAIGHT BARS

NOTE:
STRUCTURE DIMENSION AND REINFORCEMENT ARE SYMMETRICAL ABOUT ℄ OF BRIDGE AND ℄ OF SPAN

QUANTITIES

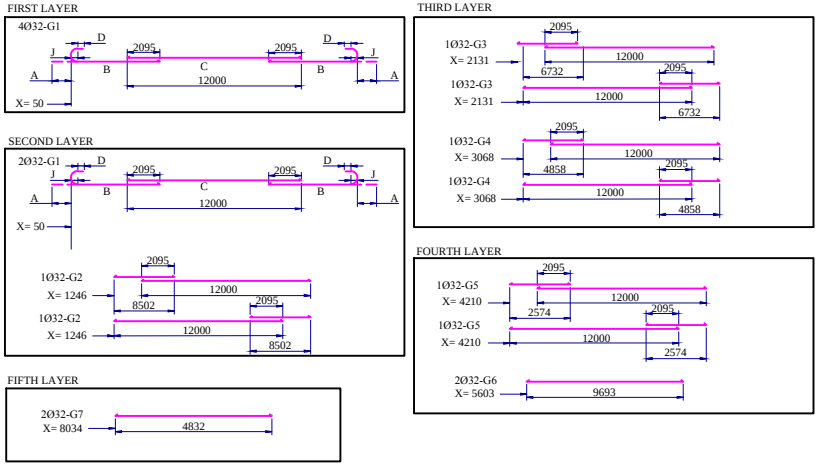
REINFORCEMENT: 17128Kg.
CONCRETE: 80.88m³

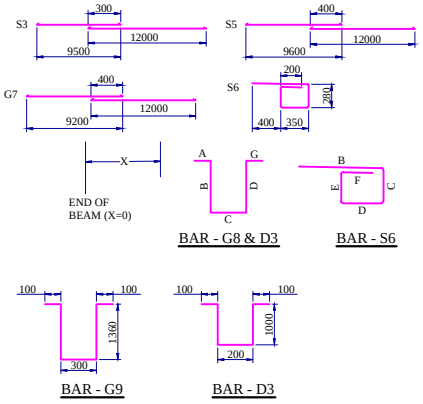
REINFORCEMENT SUMMARY			
BAR SIZE	12	16	32
TOT. Wt.	4192	5345	7591
GROSS TOT. WT. - - 17128kg			

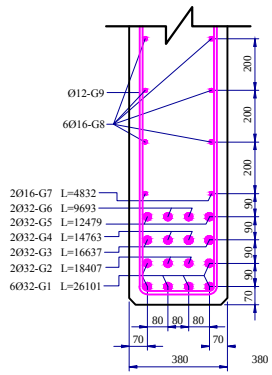
GENERAL NOTES:
MANUALS USED:-PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
LOADINGS USED:-HL-93 ACCORDING TO CHAPTER 3 OF THE ABOVE SPECIFICATIONS.
FOR DIMENSIONS: SEE DWG NO. B - 42
PROVIDE 25MM CHAMFER AT ALL EDGES.
ALL DIMENSIONS ARE IN MILLIMETERS.

MATERIAL (STRENGTH) PROPERTIES
CONCRETE :- THE MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS SHALL BE 20 MPa (GRADE 20)
REINFORCEMENT STEEL :- THE MINIMUM YIELD STRENGTH OF DEFORMED BAR SHALL BE 500 MPa IN ACCORDANCE WITH THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION
ALL BAR DIMENSIONS ARE OUT TO OUT
OVERLAP Ø12, -300mm. Ø16, -400Mmm. Ø32, -1880mm

BAR SHEDULE







GIRDER REINFORCEMENT DETAIL (SCALE 1:10)

NOTE: THE SPLICING OF BAR G'S S ALL BE VERTICALLY AS SHOWN BELOW
SPLICED BAR

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

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THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
ETHIOPIAN ROADS AUTHORITY
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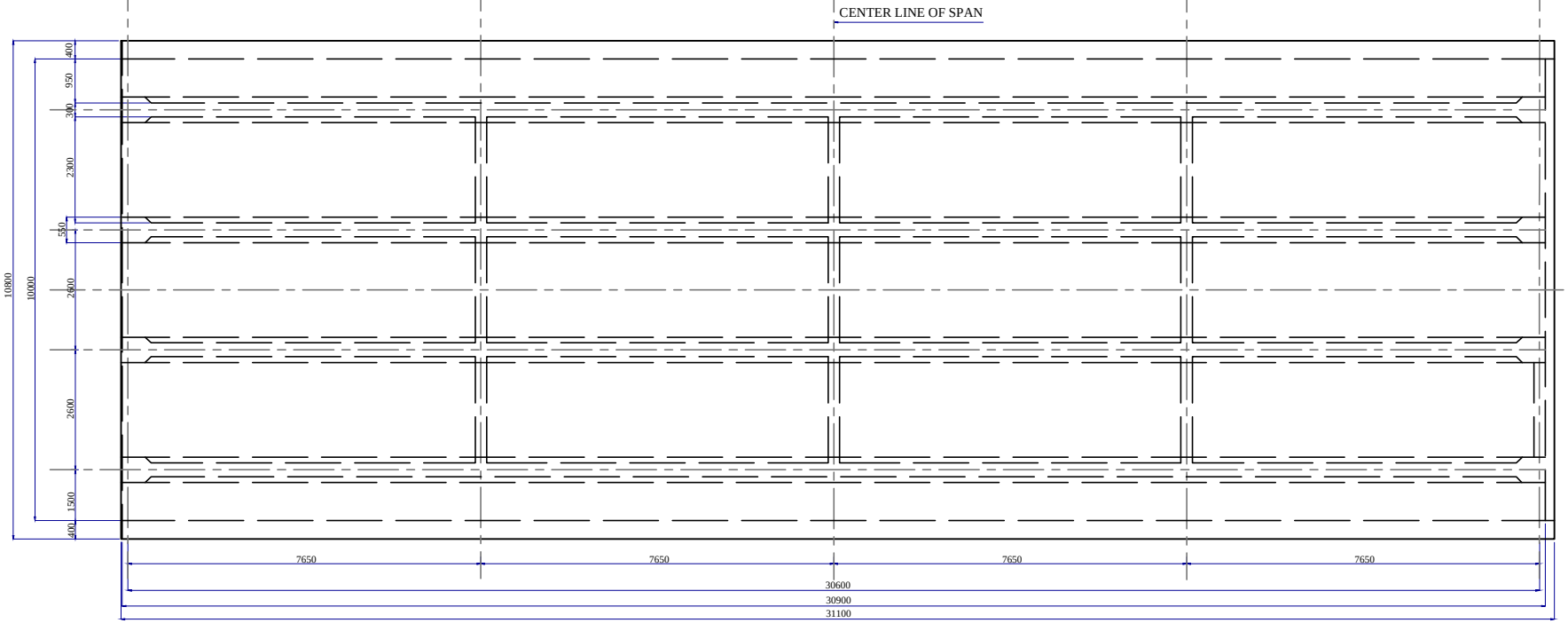
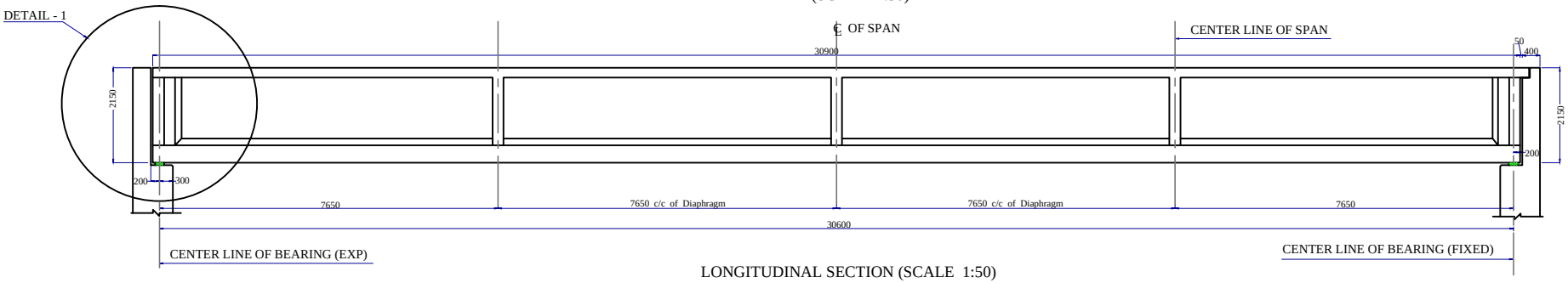
BRIDGE RC DECK GIRDER 20m. SPAN; WIDTH 10m.

SHEET 2/2

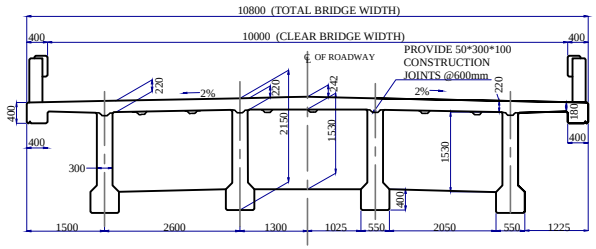
DRAWN	TESFAYE GIZAW	SCALE:	AS SHOWN
DESIGNED	TESFAYE GIZAW	DRG. NO.	B – 43
CHECKED	LEMMA ABEBE		
APPROVED	BEKELE JEBESSA	DATE	09/05/02
EDITED	STEPHEN KIRSTEN		



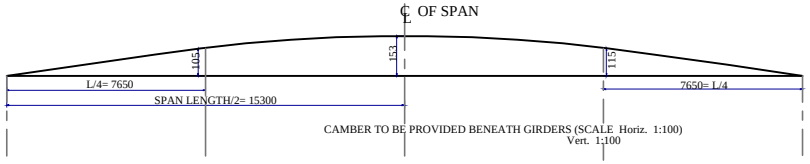
PLAN (SCALE 1:50)



LONGITUDINAL SECTION (SCALE 1:50)



TYPICAL CROSS SECTION (SCALE 1:50)



NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

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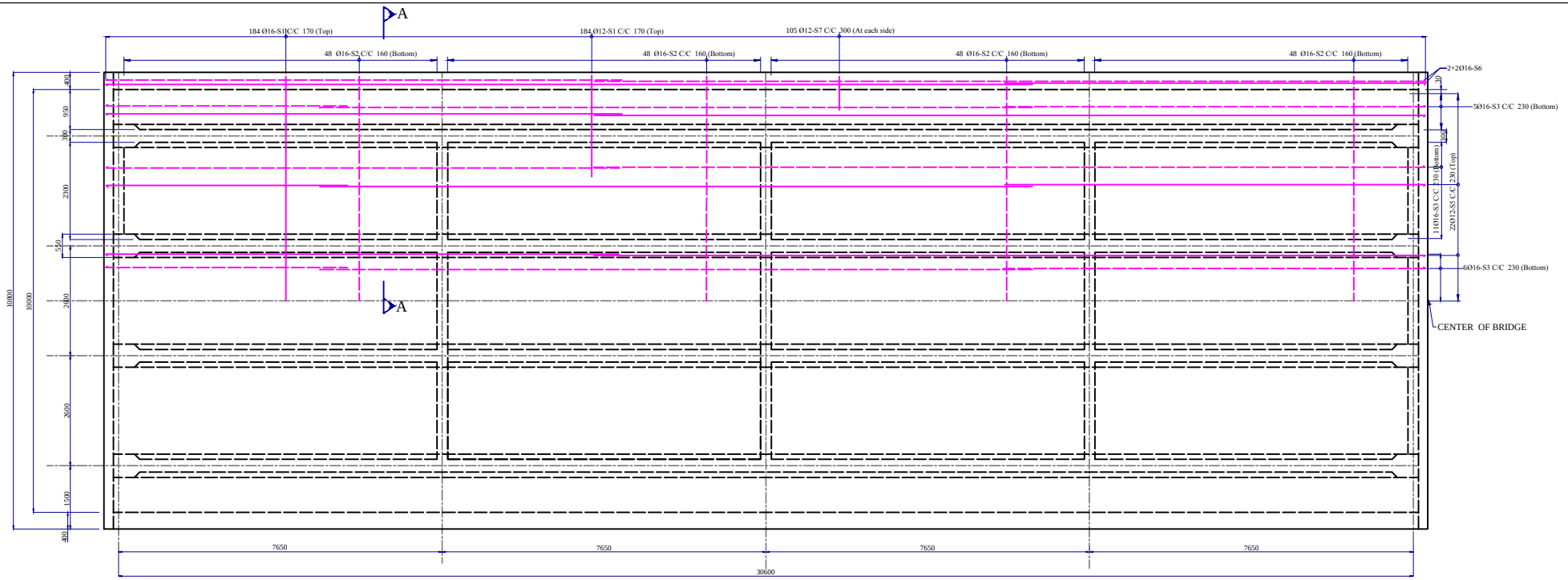
Telex 21180 Tel.No. 51-71-70/79

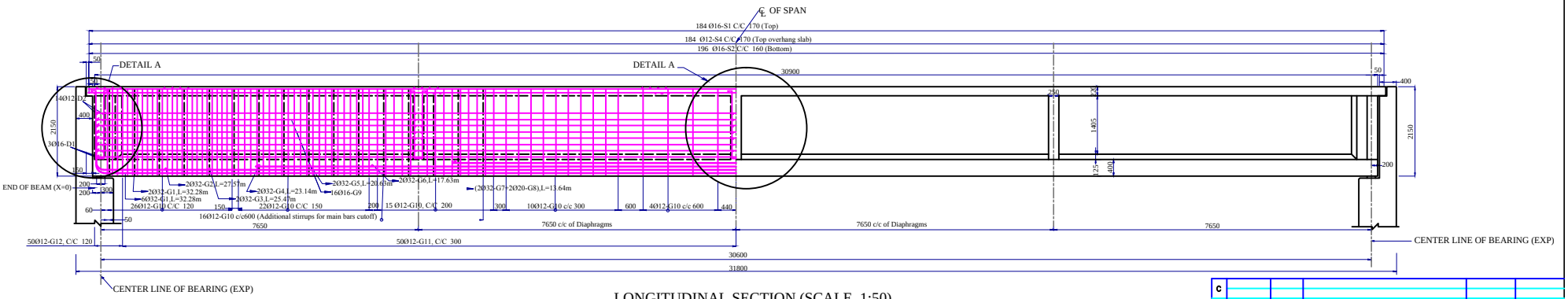
BRIDGE RC DECK GIRDER 30m. SPAN; WIDTH 10m.

SHEET 1/4

DRAWN	ASTERAYE TS.	SCALE:	DRG. NO.
DESIGNED	ASTERAYE TS.	AS SHOWN	
CHECKED	LEMMA ABEBE	DATE	B – 44
APPROVED	BEKELE JEBESSA	09/05/02	
EDITED	STEPHEN KIRSTEN		



PLAN (SCALE 1:50)



LONGITUDINAL SECTION (SCALE 1:50)

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

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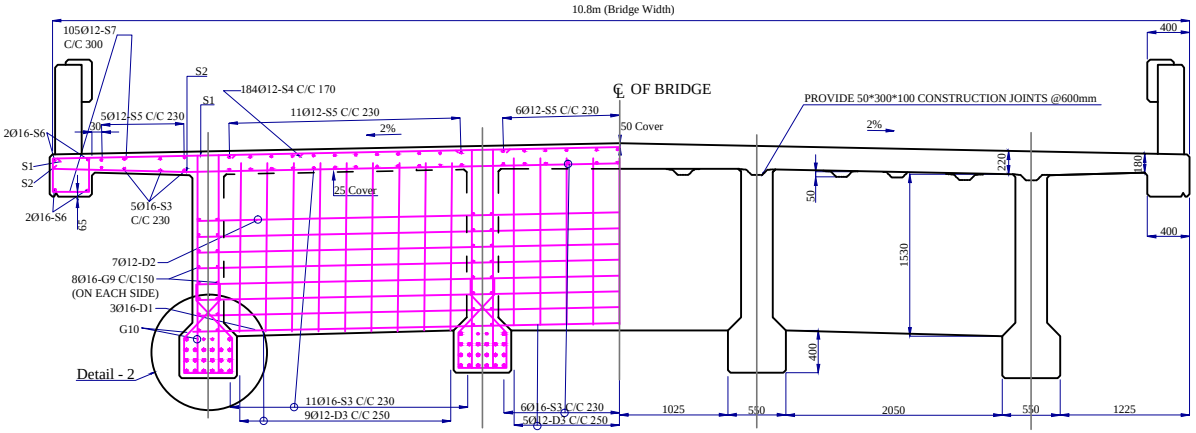
BRIDGE RC DECK GIRDER 30m. SPAN; WIDTH 10m.

SHEET 2/4

DRAWN	ASTERAYE TS.	SCALE:	DRG. NO.
DESIGNED	ASTERAYE TS.	AS SHOWN	
CHECKED	LEMMA ABEBE	DATE	B – 45
APPROVED	BEKELE JEBESSA	09/05/02	
EDITED	STEPHEN KIRSTEN		

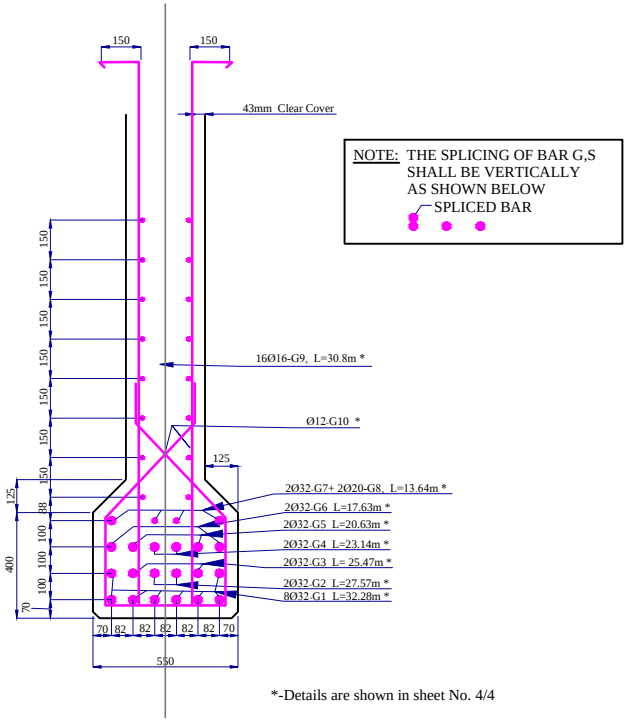


TYPICAL CROSS SECTION (SCALE 1:25)

NOTE:
STRUCTURE AND REINFORCEMENT ARE PAN SYMMETRICAL ABOUT C OF BRIDGE AND C OF S

REINFORCING BAR SCHEDULE

BAR MARK	SIZE (mm)	NUMBER	BAR TYPE	DIMENSIONS (mm) A	B	C	D	E	F	G	J	BAR LENGTH (mm)	TOTAL LENGTH (m)	TOTAL WEIGHT (Kg)
D1	16	15	Str.	-	-	-	-	-	-	-	-	8130	121.95	192.44
D2	12	70	Str.	-	-	-	-	-	-	-	-	8130	1569.1	505.36
D3	12	135	*	100	1675	200	1675	-	-	100	-	3750	506.25	449.55
G1	32	32	*	12000	12000	12000	6990	-	-	-	-	42990	1375.68	8686.96
G2	32	8	Str.	12000	12000	10710	-	-	-	-	-	34710	277.68	1753.46
G3	32	8	Str.	12000	12000	8610	-	-	-	-	-	32610	260.88	1647.37
G4	32	8	Str.	12000	12000	6280	-	-	-	-	-	30280	242.24	1529.66
G5	32	8	Str.	12000	12000	3770	-	-	-	-	-	27770	222.16	1402.87
G6	32	8	Str.	12000	9200	-	-	-	-	-	-	21200	169.6	1070.97
G7	32	8	Str.	12000	5210	-	-	-	-	-	-	17210	137.68	869.40
G8	20	8	Str.	12000	2420	-	-	-	-	-	-	14420	115.36	284.55
G9	16	64	Str.	12000	12000	8100	-	-	-	-	-	32100	2054.4	3241.84
G10	12	744	*	150	2060	202	2060	150	-	-	-	4622	3438.77	3053.63
G11	12	400	*	150	495	332	466	332	495	150	-	2420	968	859.58
G12	12	40	*	150	2060	466	2060	150	-	-	-	4886	195.44	173.55
S1	16	184	Str.	-	-	-	-	-	-	-	-	10750	1978.0	3121.28
S2	16	196	Str.	-	-	-	-	-	-	-	-	10750	2107.0	3324.85
S3	16	41	Str.	12000	12000	8500	-	-	-	-	-	32500	1332.5	2102.69
S4	12	368	Str.	-	-	-	-	-	-	-	-	2400	883.2	784.28
S5	12	41	Str.	12000	12000	8500	-	-	-	-	-	32500	1332.5	1183.26
S6	16	8	Str.	12000	12000	8500	-	-	-	-	-	32500	260.00	410.28
S7	12	208	*	-	750	280	350	280	200	-	-	1860	386.68	343.55
													TOTAL =	36,991.38 Kg



*-Details are shown in sheet No. 4/4

GIRDER REINFORCEMENT DETAIL
(SCALE 1:10)

GENERAL NOTES:

MANUALS USED: - PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL

LOADINGS USED: - HL-93 ACCORDING
TO CHAPTER 3 OF THE ABOVE SPECIFICATIONS.
PROVIDE 25mm CHAMFER AT ALL EDGES.

PROVIDE 1.00% Longitudinal Camber towards the center of Span.
ALL DIMENSIONS ARE IN MILLIMETERS..

The Structure is Symmetrical about Center of Span and Roadway.

Bars shall be Spliced with adjacent bars Staggered by 1.50m Minimum.

MATERIAL (STRENGTH) PROPERTIES

CONCRETE: - THE MINIMUM CYLINDRICAL COMPRESSIVE
STRENGTH AT 28 DAYS SHALL BE 20Mpa (GRADE 20).

REINFORCEMENT STEEL :- THE MINIMUM YIELD STRENGTH
OF DEFORMED BAR SHALL BE 500 Mpa For Bar Dia.>=20mm and
350Mpa For Bar Dia. <20mm IN ACCORDANCE WITH THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL.

FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION

ALL BAR DIMENSIONS ARE OUT TO OUT including their Splices.

OVERLAP Ø12, -500mm. Ø16, -650mm. Ø20, -780mm. Ø32, -3570mm.

SIDE WALKS

IF SIDE WALKS ARE REQUIRED, REFER TO DRAWING B-35 FOR EDGE BEAMS.

REINFORCEMENT SUMMARY				
BAR SIZE	12	16	20	32
TOT. Wt.	7352.82	12393.38	284.55	16960.69
GROSS TOT. Wt.- -36,991.38 kg				

REINFORCEMENT: 37,565 Kg.
CONCRETE: 179.20m³

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

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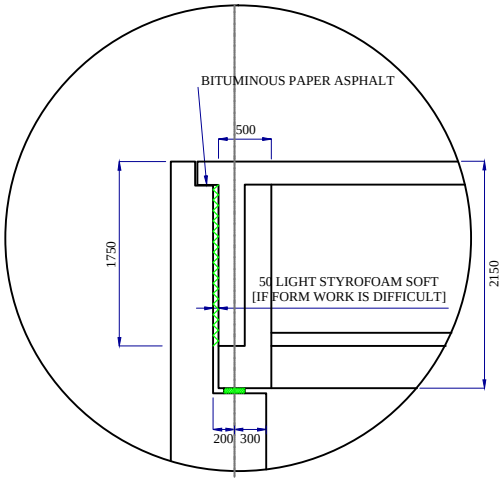
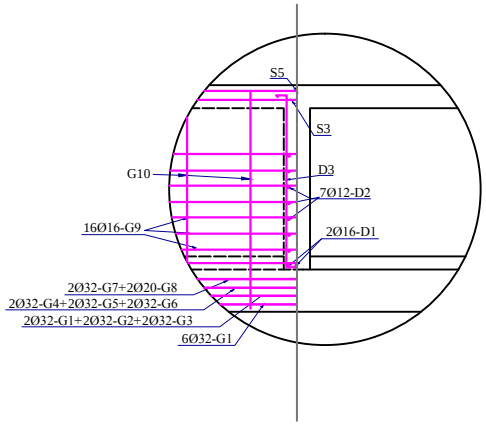
BRIDGE RC DECK GIRDER 30m. SPAN; WIDTH 10m.

SHEET 3/4

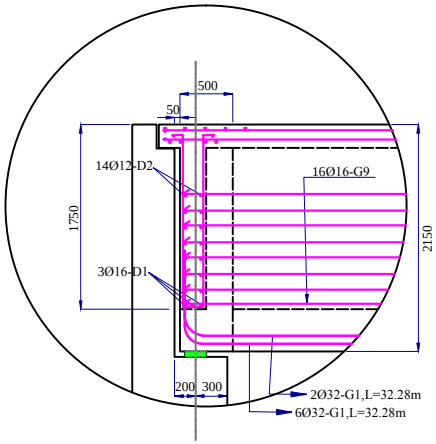
DRAWN	ASTERAYE TS.	SCALE:	DRG. NO.
DESIGNED	ASTERAYE TS.	AS SHOWN	
CHECKED	LEMMA ABEBE	DATE	B – 46
APPROVED	BEKELE JEBESSA	09/05/02	
EDITED	STEPHEN KIRSTEN		



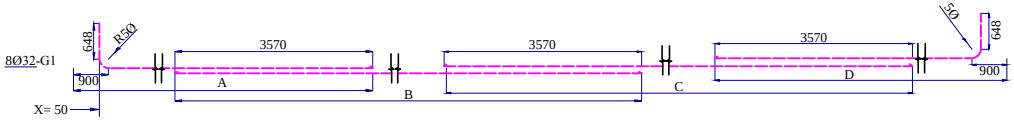
FIXED JOINT DETAIL (SCALE 1:25)

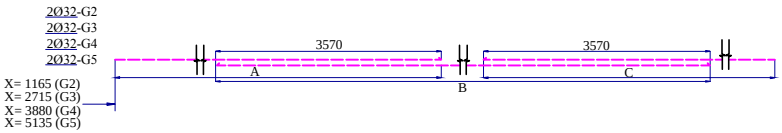


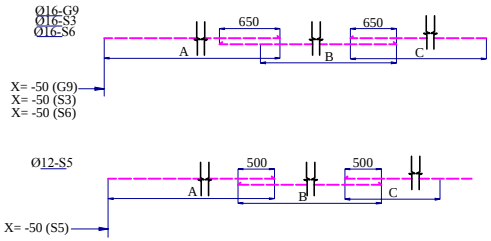
DETAIL B (SCALE 1:25)

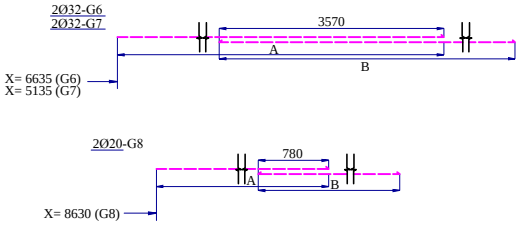


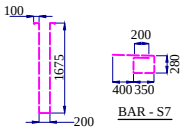
DETAIL A (SCALE 1:25)





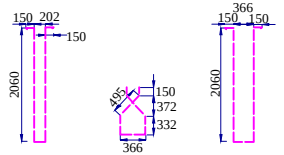






BAR - D3

BAR - S7



G10 Stirrup G11 Stirrup G12 Stirrup

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

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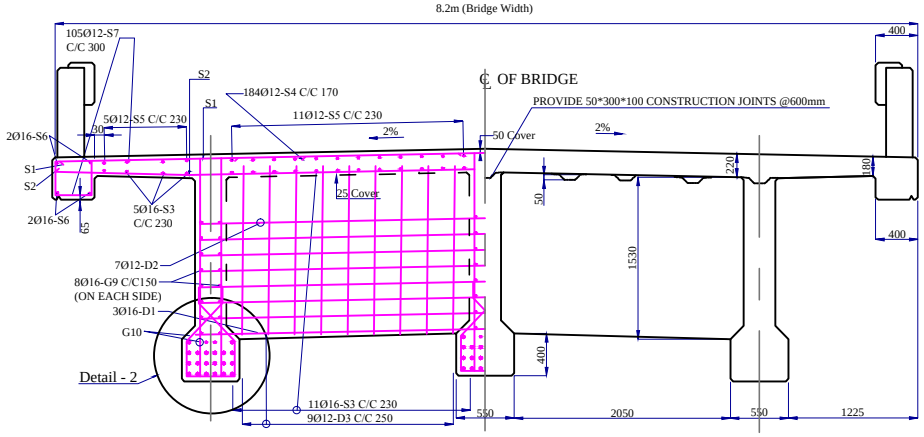
BRIDGE RC DECK GIRDER 30m. SPAN; WIDTH 10m.

SHEET 4/4

DRAWN	ASTERAYE TS.	SCALE:	DRG. NO.
DESIGNED	ASTERAYE TS.	AS SHOWN	
CHECKED	LEMMA ABEBE	DATE	B – 47
APPROVED	BEKELE JEBESSA	09/05/02	
EDITED	STEPHEN KIRSTEN		

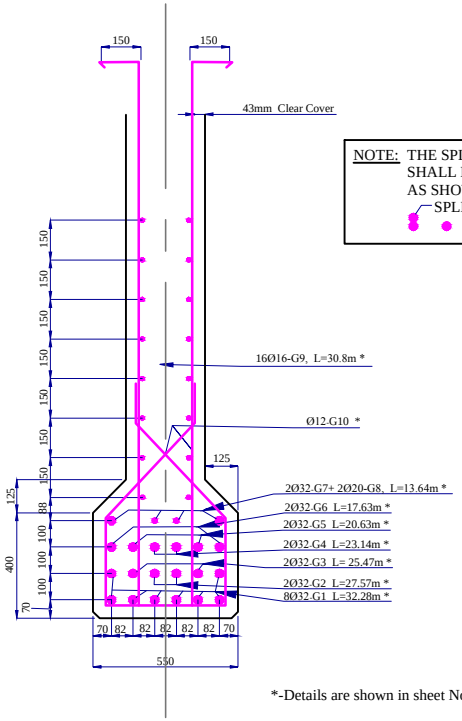


TYPICAL CROSS SECTION (SCALE 1:25)

NOTE:
STRUCTURE DIMENSION AND REINFORCEMENT ARE SYMMETRICAL ABOUT $\mathcal{C}_L$ OF BRIDGE AND $\mathcal{C}_L$ OF SPAN.

REINFORCING BAR SCHEDULE

BAR MARK	SIZE (mm)	NUMBER	BAR TYPE	DIMENSIONS (mm) A	B	C	D	E	F	G	J	BAR LENGTH (mm)	TOTAL LENGTH (m)	TOTAL WEIGHT (Kg)
D1	16	15	Str.	-	-	-	-	-	-	-	-	5530	82.95	131
D2	12	70	Str.	-	-	-	-	-	-	-	-	5530	387.10	344
D3	12	90	*	100	1675	200	1675	-	-	100	-	3750	337.50	300
G1	32	24	*	12000	12000	12000	6990	-	-	-	-	42990	1032	6514
G2	32	6	Str.	12000	12000	10710	-	-	-	-	-	34710	208	1315
G3	32	6	Str.	12000	12000	8610	-	-	-	-	-	32610	196	1235
G4	32	6	Str.	12000	12000	6280	-	-	-	-	-	30280	182	1147
G5	32	6	Str.	12000	12000	3770	-	-	-	-	-	27770	167	1052
G6	32	6	Str.	12000	9200	-	-	-	-	-	-	21200	127	803
G7	32	6	Str.	12000	5210	-	-	-	-	-	-	17210	103	652
G8	20	6	Str.	12000	2420	-	-	-	-	-	-	14420	87	213
G9	16	48	Str.	12000	12000	8100	-	-	-	-	-	32100	1541	2431
G10	12	744	*	150	2060	202	2060	150	-	-	-	4622	3439	3054
G11	12	400	*	150	495	332	466	332	495	150	-	2420	968	860
G12	12	30	*	150	2060	466	2060	150	-	-	-	4886	147	130
S1	16	184	Str.	-	-	-	-	-	-	-	-	8150	1500	2366
S2	16	192	Str.	-	-	-	-	-	-	-	-	8150	1565	2469
S3	16	32	Str.	12000	12000	8500	-	-	-	-	-	32500	1040	1641
S4	12	368	Str.	-	-	-	-	-	-	-	-	2400	883	784
S5	12	32	Str.	12000	12000	8500	-	-	-	-	-	32500	1040	924
S6	16	8	Str.	12000	12000	8500	-	-	-	-	-	32500	260	410
S7	12	208	*	-	750	280	350	280	200	-	-	1860	387	344
													TOTAL =	29119 Kg



*-Details are shown in sheet No. 4/4

GIRDER REINFORCEMENT DETAIL
(SCALE 1:10)

NOTE: THE SPLICING OF BAR G,S SHALL BE VERTICALLY AS SHOWN BELOW
SPLICED BAR

GENERAL NOTES:

MANUALS USED: - THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL

LOADINGS USED: - HL-93 ACCORDING TO CHAPTER 3 OF THE ABOVE SPECIFICATIONS.
PROVIDE 25mm CHAMFER AT ALL EDGES.

PROVIDE 1.00% Longitudinal Camber towards the center of Span.
ALL DIMENSIONS ARE IN MILLIMETERS..

The Structure is Symmetrical about Center of Span and Roadway.

Bars shall be Spliced with adjacent bars Staggered by 1.50m Minimum.

SIDE WALKS

IF SIDE WALKS ARE REQUIRED, REFER TO DRAWING B-35

MATERIAL (STRENGTH) PROPERTIES

CONCRETE: - THE MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS SHALL BE 20Mpa (GRADE 20).

REINFORCEMENT STEEL :- THE MINIMUM YIELD STRENGTH OF DEFORMED BAR SHALL BE 500 Mpa For Bar Dia.>=20mm and 350Mpa For Bar Dia. <20mm IN ACCORDANCE WITH THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL.

FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION

ALL BAR DIMENSIONS ARE OUT TO OUT including their Splices.

OVERLAP Ø12, -500mm. Ø16, -650mm. Ø20, -780mm. Ø32, -3570mm.

REINFORCEMENT SUMMARY				
BAR SIZE	12	16	20	32
TOT. Wt.	6740	9448	213	12718
GROSS TOT. Wt.- -29119 kg				

REINFORCEMENT: 29119 Kg.
CONCRETE: 154m³

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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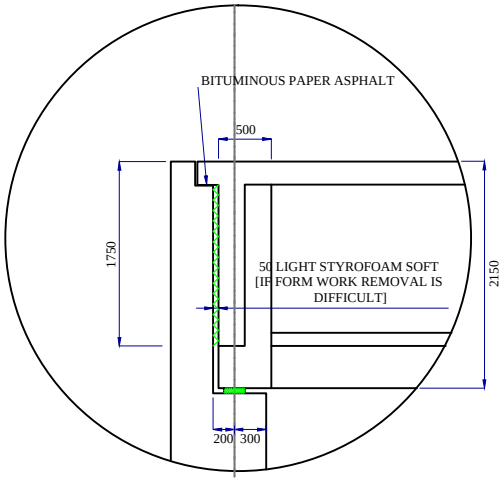
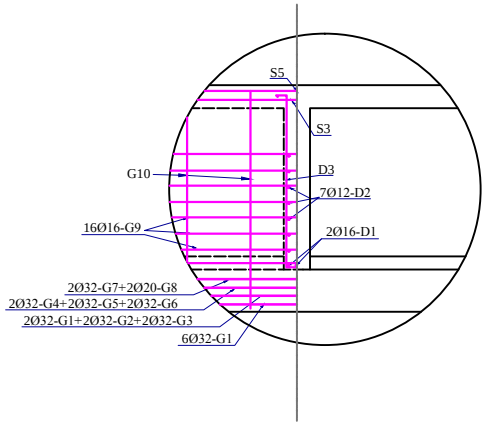
Telex 21180 Tel.No. 51-71-70/79

BRIDGE RC DECK GIRDER 30m. SPAN; WIDTH 7.3m

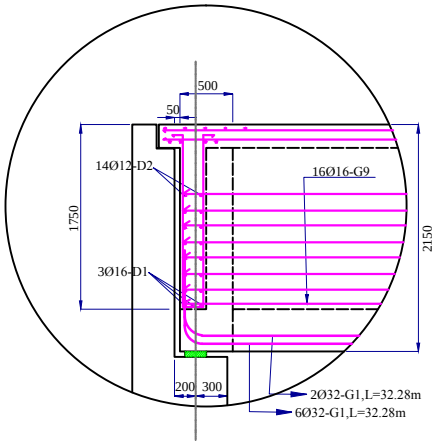
DRAWN	ASTERAYE TS.	SCALE:	DRG. NO.
DESIGNED	ASTERAYE TS.	AS SHOWN	
CHECKED	LEMMA ABEBE	DATE	B – 52
APPROVED	BEKELE JEBESSA	09/05/02	
EDITED	STEPHEN KIRSTEN		



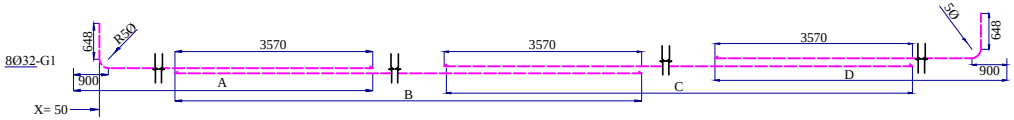
FIXED JOINT DETAIL (SCALE 1:25)

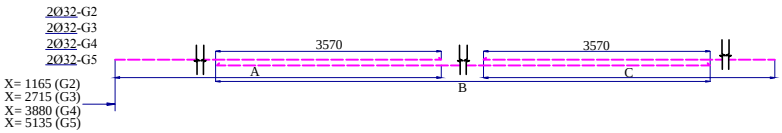


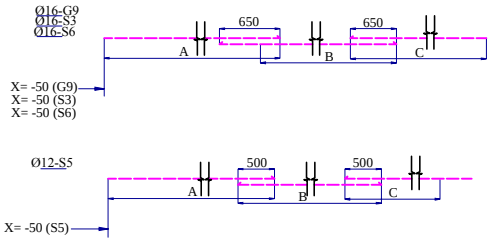
DETAIL B (SCALE 1:25)

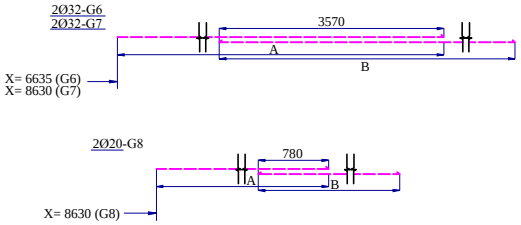


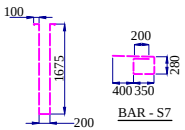
DETAIL A (SCALE 1:25)

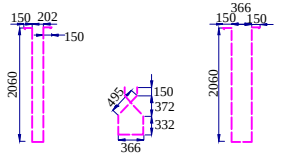












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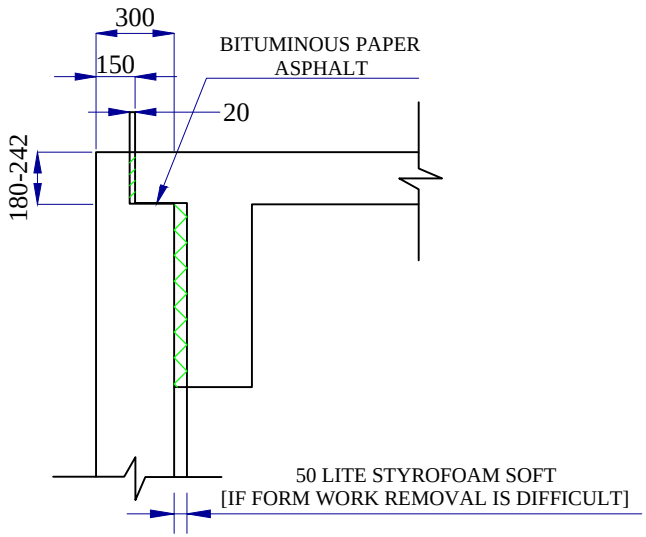
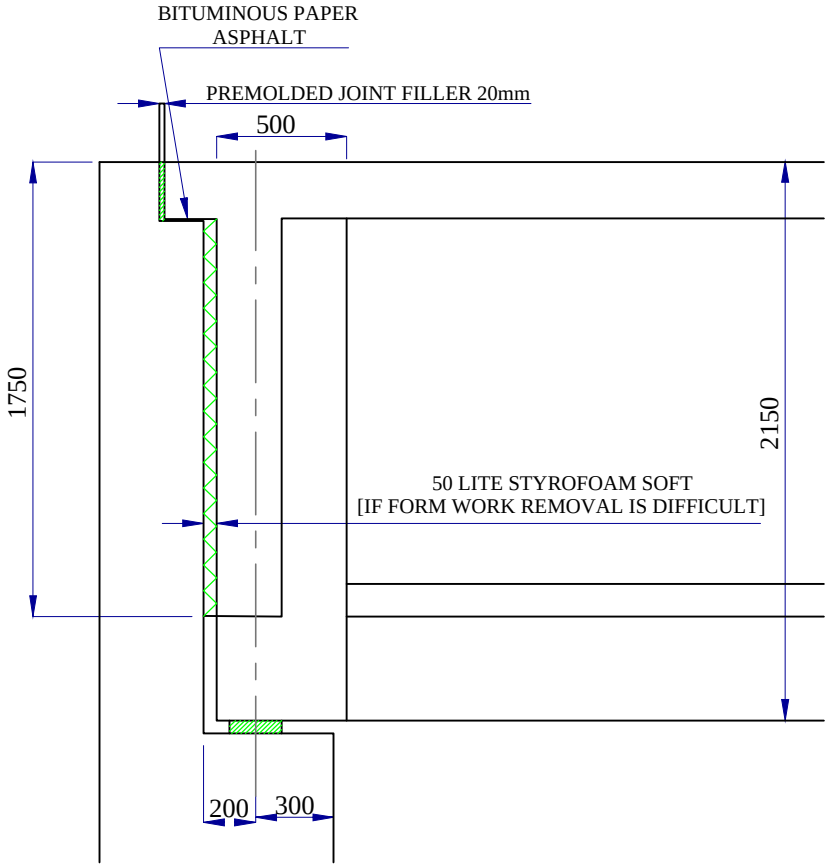
BRIDGE RC DECK GIRDER 30m. SPAN; WIDTH 7.3m

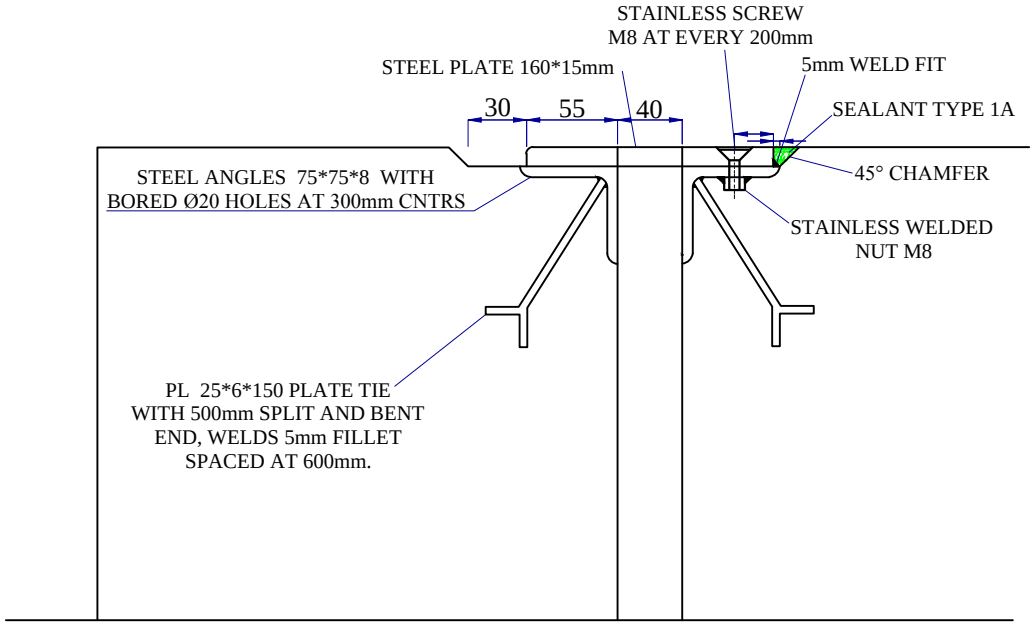
DRAWN	ASTERAYE TS.	SCALE:	DRG. NO.
DESIGNED	ASTERAYE TS.	AS SHOWN	
CHECKED	LEMMA ABEBE	DATE	B – 53
APPROVED	BEKELE JEBESSA	09/05/02	
EDITED	STEPHEN KIRSTEN		



DETAIL-1 (SCALE 1:25)
(FOR 20m SPAN)



FIXED JOINT DETAIL (SCALE 1:25)
(FOR 30m SPAN)



EXPANSION JOINT DETAIL (SCALE 1:10)
(FOR 30m SPAN)

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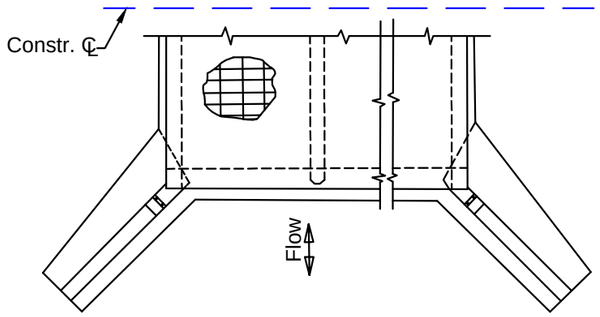
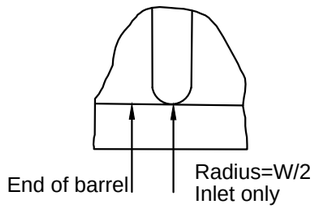
JOINT DETAILS FOR 20 AND 30m SPAN
BRIDGES WIDTH 7.3m OR 10m.

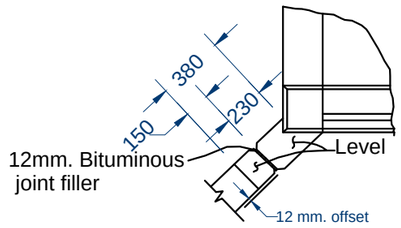
DRAWN	ASTERAYE TS.	SCALE:	DRG. NO.
DESIGNED	ASTERAYE TS.	AS SHOWN	
CHECKED	LEMMA ABEBE	DATE	B – 54
APPROVED	BEKELE JEBESSA	20/12/02	
EDITED	STEPHEN KIRSTEN		



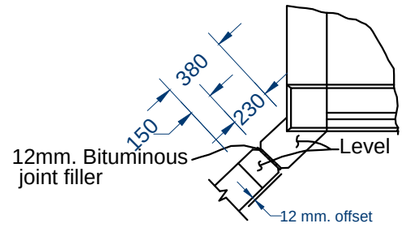
PART PLAN
Showing Inlet & Outlet Details



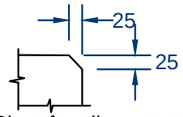
SECTION B-B
TYPICAL DETAILS



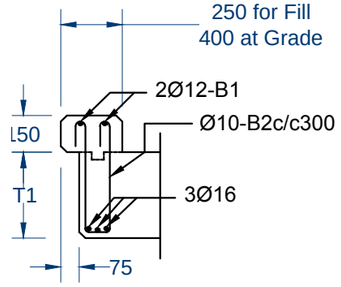
WINGWALL JOINT DETAIL
For all barrels 3m. and over (H ≥ 3m.)

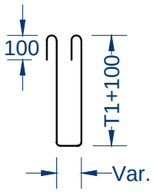


WINGWALL JOINT DETAIL
For all barrels under 3m. (H < 3m.)



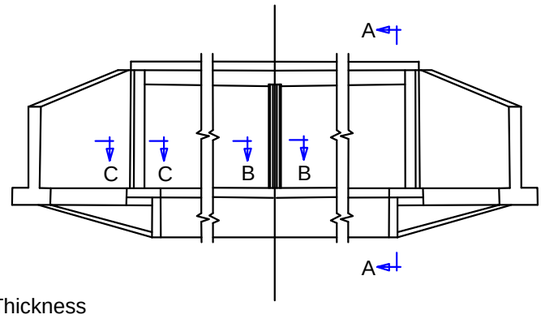
Chamfer all exposed
Unless otherwise noted.
This note applicable to
all culvert Sheets pertaining
to the project.



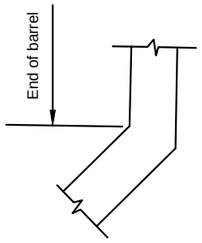


BAR-B2

EDGE BEAM DETAIL B (SC. 1:25)
* WHERE T1 IS TOP SLAB THICKNESS



TYPICAL ELEVATION



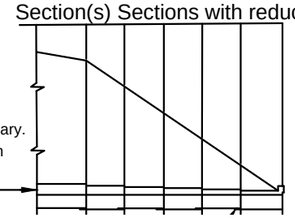
SECTION C-C

LEGEND

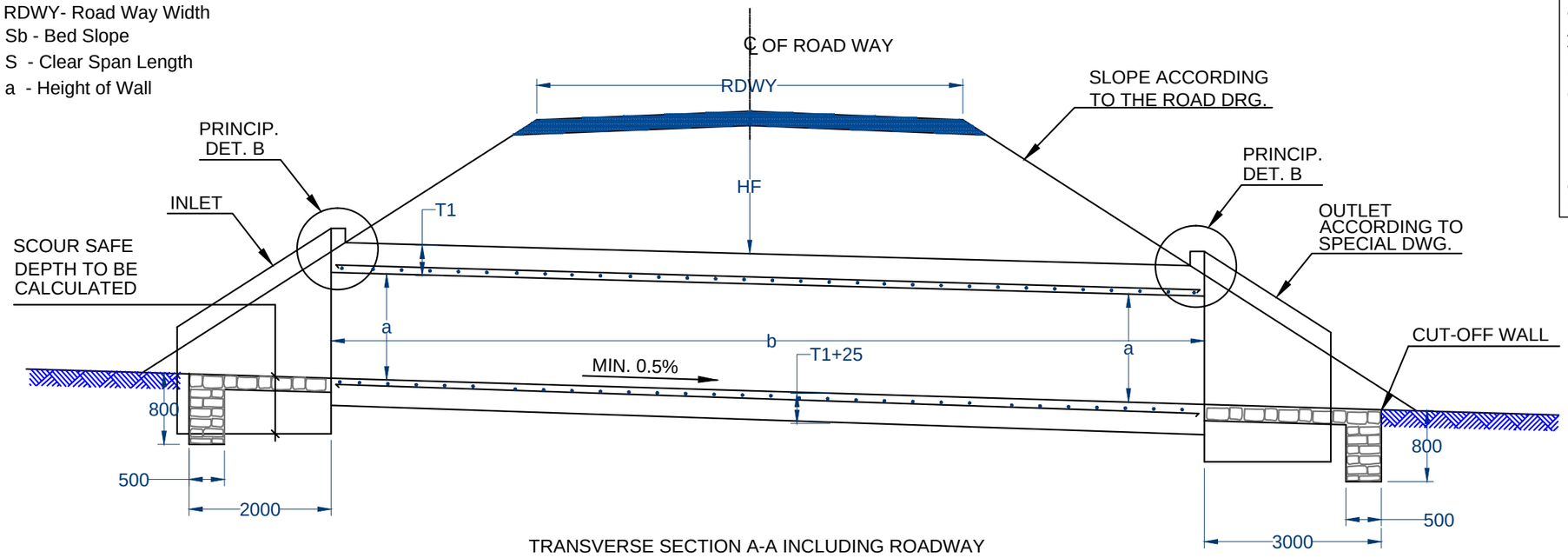
T1 - Top Slap Thickness
W - Width of Wall
HF - Height of Fill
b - Width of Slab
(Length of Abutment)
RDWY- Road Way Width
Sb - Bed Slope
S - Clear Span Length
a - Height of Wall

Scale: NTS

Special
Section(s) Sections with reducing fill heights



NOTE:
Specially designed sections shall be used along with the standard barrels when necessary. Thicknesses of top and bottom slabs vary with depths of fill as shown.



TRANSVERSE SECTION A-A INCLUDING ROADWAY
Scale 1:75

GENERAL NOTES:

Manual used: The prevailing version of the ERA Bridge Design Manual
Loading used: HL-93 Load
All dimensions are in millimeters.
All bend dimensions are out to out of bar.
All reinforcing steel shall have the specified clear cover.

Joint Notes:
All structures shall have formed construction joints in top slab and walls (optional in floor slab) spaced not more than 12m.
Apart or as shown, reinforcing steel shall project 500 mm. thru. the joint.

Material (Strength) Properties:
Concrete: The minimum cylindrical compressive strength at 28 days shall be 20MPa. (Grade 20)
Reinforcement Steel: The minimum yield strength of deformed bar shall be 500 MPa in accordance with the prevailing version of the ERA Bridge Design Manual.
Overlap for the longitudinal reinf. Ø12-300mm.
For class of finish refer to Technical Specification.

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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BOX CULVERTS MISCELLANEOUS DETAILS

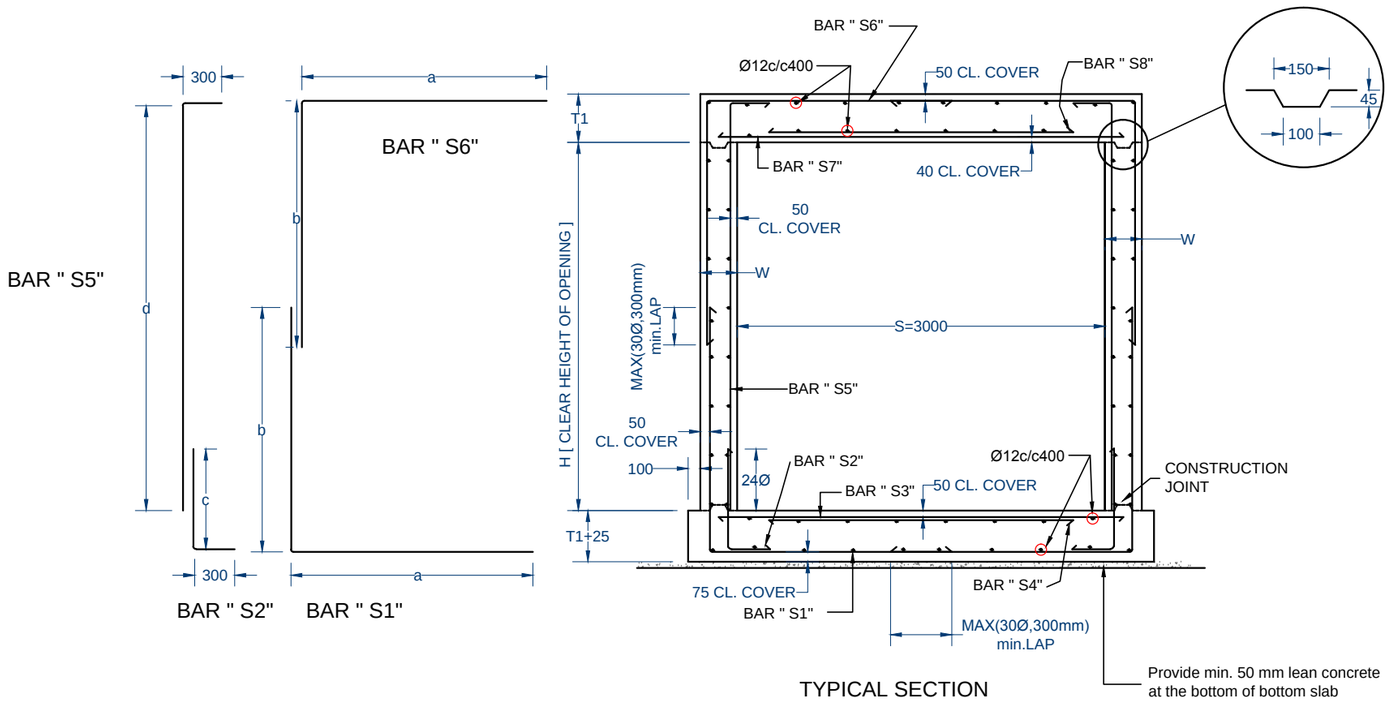
DRAWN		
DESIGNED		SCALE:As shown (at A3)
CHECKED		
APPROVED	B. JEBESSA	DATE: December 2011
EDITED	S. KIRSTEN	

DRAWING NUMBER
C-01

CLEAR SPAN [m]	Wall HEIGHT [m]	FILL HEIGHT, H_f [m]	TOP SLAB THICKNESS,T1 [mm]	WALL THICKNESS, W [mm]	BOTTOM SLAB REINFORCEMENT										TOP SLAB REINFORCEMENT										EXTERIOR WALL INTERNAL REINFORCEMENT								QUANTITY PER METER WIDTH OF BARREL		FILL HEIGHT, H_f [m]	Wall HEIGHT [m]	CLEAR SPAN [m]
					BAR-S1					BAR-S3			BAR-S4			BAR-S6					BAR-S7			BAR-S8			BAR-S2				BAR-S5							
					Ø	Spacing [mm]	a [mm]	b [mm]	Length [mm]	Ø	Spacing [mm]	LENGTH [mm]	Ø	Spacing [mm]	Length [mm]	Ø	Spacing [mm]	a [mm]	b [mm]	Length [mm]	Ø	Spacing [mm]	LENGTH [mm]	Ø	Spacing [mm]	Length [mm]	Ø	Spacing [mm]	c [mm]	Length [mm]	Ø	Spacing [mm]	d [mm]	Length [mm]	CONCRETE [m^3]	REINFORCEMENT STEEL [KG]			
3.00	2.00	H_f < 0.65	290	250	12	140	1880	1420	3300	16	340	3400	16	340	2440	16	210	1880	1420	3300	16	280	3400	16	280	2440	12	170	530	830	12	170	2240	2540	3.18	234.68	H_f < 0.65	2.00	3.00
		0.65 <=H_f< 1.20	250	250	12	130	1880	1380	3260	16	340	3400	16	340	2440	16	220	1880	1380	3260	16	320	3400	16	320	2440	12	320	490	790	12	320	2200	2500	2.89	213.46	0.65 <=H_f< 1.20		
		1.20 <=H_f< 2.20	250	250	16	210	1940	1440	3380	16	300	3400	16	300	2440	16	200	1940	1440	3380	16	320	3400	16	320	2440	12	320	490	790	12	320	2200	2500	2.89	229.93	1.20 <=H_f< 2.20		
		2.20 <=H_f< 3.20	290	250	16	190	1940	1480	3420	16	260	3400	16	260	2440	16	180	1940	1480	3420	16	280	3400	16	280	2440	12	320	530	830	12	320	2240	2540	3.18	251.86	2.20 <=H_f< 3.20		
		3.20 <=H_f< 4.20	330	250	16	190	1940	1520	3460	16	240	3400	16	240	2440	16	170	1940	1520	3460	20	380	3400	20	380	2440	12	320	570	870	12	320	2280	2580	3.47	265.18	3.20 <=H_f< 4.20		
		4.20 <=H_f< 5.20	380	250	16	170	1940	1570	3510	20	320	3400	20	320	2440	16	160	1940	1570	3510	20	320	3400	20	320	2440	12	320	620	920	12	320	2330	2630	3.83	292.14	4.20 <=H_f< 5.20		
		5.20 <=H_f< 6.20	440	250	16	160	1940	1630	3570	20	280	3400	20	280	2440	16	160	1940	1630	3570	20	300	3400	20	300	2440	12	320	680	980	12	320	2390	2690	4.26	308.68	5.20 <=H_f< 6.20		
		6.20 <=H_f< 7.20	510	250	16	160	1940	1700	3640	20	280	3400	20	280	2440	16	150	1940	1700	3640	20	280	3400	20	280	2440	12	320	750	1050	12	320	2460	2760	4.76	320.44	6.20 <=H_f< 7.20		
		7.20 <=H_f< 8.00	550	250	16	140	1940	1740	3680	20	260	3400	20	260	2440	16	140	1940	1740	3680	24	420	3400	24	420	2440	12	170	790	1090	12	170	2500	2800	5.05	359.37	7.20 <=H_f< 8.00		
	3.00	H_f < 0.65	290	250	12	120	1880	1920	3800	16	320	3400	16	320	2440	16	210	1880	1920	3800	16	260	3400	16	260	2440	12	170	530	830	12	170	3240	3540	3.68	271.25	H_f < 0.65	3.00	
		0.65 <=H_f< 1.20	250	250	16	200	1940	1940	3880	16	320	3400	16	320	2440	16	200	1940	1940	3880	16	300	3400	16	300	2440	12	170	490	790	12	170	3200	3500	3.39	274.82	0.65 <=H_f< 1.20		
		1.20 <=H_f< 2.20	250	250	16	170	1940	1940	3880	16	300	3400	16	300	2440	16	180	1940	1940	3880	16	320	3400	16	320	2440	12	170	490	790	12	170	3200	3500	3.39	292.43	1.20 <=H_f< 2.20		
		2.20 <=H_f< 3.20	290	250	16	170	1940	1980	3920	16	300	3400	16	300	2440	16	180	1940	1980	3920	16	320	3400	16	320	2440	12	170	530	830	12	170	3240	3540	3.68	294.71	2.20 <=H_f< 3.20		
		3.20 <=H_f< 4.20	330	250	16	140	1940	2020	3960	20	380	3400	20	380	2440	16	150	1940	2020	3960	20	400	3400	20	400	2440	12	170	570	870	12	170	3280	3580	3.97	341.02	3.20 <=H_f< 4.20		
		4.20 <=H_f< 5.20	380	250	16	120	1940	2070	4010	20	340	3400	20	340	2440	16	130	1940	2070	4010	20	340	3400	20	340	2440	12	170	620	920	12	170	3330	3630	4.33	383.12	4.20 <=H_f< 5.20		
		5.20 <=H_f< 6.20	440	250	20	170	2000	2190	4190	20	300	3400	20	300	2440	20	180	2000	2190	4190	20	300	3400	20	300	2440	12	170	680	980	12	170	3390	3690	4.76	429.20	5.20 <=H_f< 6.20		
		6.20 <=H_f< 7.20	520	270	20	160	2020	2270	4290	20	300	3400	20	300	2460	20	170	2020	2270	4290	20	300	3400	20	300	2460	12	160	760	1060	12	160	3470	3770	5.50	455.05	6.20 <=H_f< 7.20		
		7.20 <=H_f< 8.00	560	280	20	150	2030	2310	4340	20	280	3400	20	280	2460	20	160	2030	2310	4340	20	280	3400	20	280	2460	12	150	800	1100	12	150	3510	3810	5.87	486.42	7.20 <=H_f< 8.00		
	4.00	H_f < 0.65	290	250	16	160	1940	2480	4420	16	340	3400	16	340	2440	16	170	1940	2480	4420	16	280	3400	16	280	2440	12	160	530	830	12	160	4240	4540	4.18	336.91	H_f < 0.65	4.00	
		0.65 <=H_f< 1.20	250	250	16	140	1940	2440	4380	16	320	3400	16	320	2440	16	170	1940	2440	4380	16	320	3400	16	320	2440	12	150	490	790	12	150	4200	4500	3.89	348.33	0.65 <=H_f< 1.20		
		1.20 <=H_f< 2.20	250	250	20	190	2000	2500	4500	16	320	3400	16	320	2440	16	140	2000	2500	4500	16	340	3400	16	340	2440	12	140	490	790	12	140	4200	4500	3.89	389.31	1.20 <=H_f< 2.20		
		2.20 <=H_f< 3.20	300	270	20	200	2020	2550	4570	16	340	3400	16	340	2460	16	150	2020	2550	4570	16	400	3400	16	400	2460	12	160	540	840	12	160	4250	4550	4.44	367.39	2.20 <=H_f< 3.20		
		3.20 <=H_f< 4.20	330	290	20	170	2040	2580	4620	16	280	3400	16	280	2470	20	200	2040	2580	4620	20	480	3400	20	480	2470	12	150	570	870	12	150	4280	4580	4.84	424.48	3.20 <=H_f< 4.20		
		4.20 <=H_f< 5.20	380	290	20	150	2040	2630	4670	20	380	3400	20	380	2470	20	160	2040	2630	4670	20	400	3400	20	400	2470	12	150	620	920	12	150	4330	4630	5.21	486.26	4.20 <=H_f< 5.20		
		5.20 <=H_f< 6.20	450	320	20	140	2070	2700	4770	20	340	3400	20	340	2490	20	150	2070	2700	4770	20	360	3400	20	360	2490	12	140	690	990	12	140	4400	4700	6.02	529.43	5.20 <=H_f< 6.20		
		6.20 <=H_f< 7.20	520	340	20	130	2090	2770	4860	20	320	3400	20	320	2510	20	140	2090	2770	4860	20	340	3400	20	340	2510	16	230	860	1160	16	230	4470	4770	6.75	575.08	6.20 <=H_f< 7.20		
		7.20 <=H_f< 8.00	580	360	24	210	2170	2890	5060	20	300	3400	20	300	2520	20	130	2170	2890	5060	20	320	3400	20	320	2520	16	210	920	1220	16	210	4530	4830	7.41	598.37	7.20 <=H_f< 8.00		

*All longitudinal bars are included in the quantity.

NOTE:
- Lap splice at the mid span of slab or wall is in compression and is taken to be 30 times bar diameter with a 300 mm minimum.
- Headwall and cutoff wall quantity is not included in the table above.



TYPICAL SECTION

GENERAL NOTES:

Manual used: The prevailing version of the ERA Bridge Design Manual

Loading used: HL-93 Load

All dimensions are in millimeters.

All bend dimensions are out to out of bar.

All reinforcing steel shall have the specified clear cover.

Joint Notes:

All structures shall have formed construction joints in top slab and walls (optional in floor slab) spaced not more than 12m. Apart or as shown, reinforcing steel shall project 500 mm. thru. the joint.

Material (Strength) Properties:

Concrete: The minimum cylinderical compressive strength at 28 days shall be 20MPa.

Reinforcement Steel: The minimum yield strength of deformed bar shall be 500 MPa in accordance with the prevailing version of the ERA Bridge Design Manual.

Overlap for the longitudinal reinf. Ø12-300mm.

For class os finish refer to Technical Specification.

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

REVISIONS

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

ETHIOPIAN ROADS AUTHORITY

Post Office Box 1770 Addis Ababa Ethiopia
Cable Address Highways Addis Ababa
Telex 21180 Tel.No. 51-71-70/79

BOX CULVERT SINGLE 3m CLEAR SPAN, 2-4m WALL HEIGHT AND FILL 0-8m

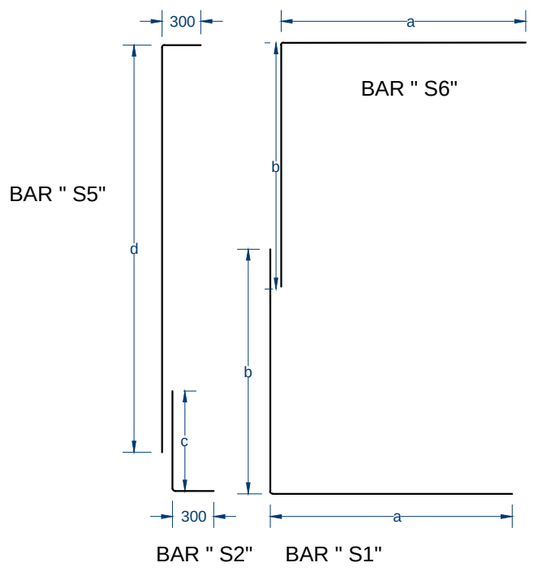
DRAWN		SCALE: 1:50 (at A3)	DRAWING NUMBER C-02
DESIGNED			
CHECKED			
APPROVED	B. JEBESSA	DATE: December 2011	
EDITED	S. KIRSTEN		

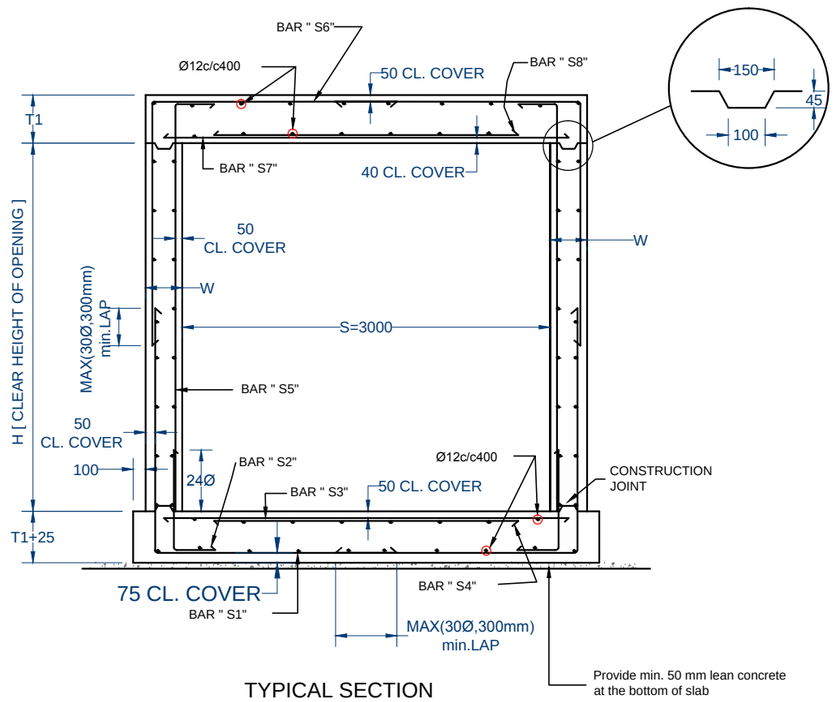
CLEAR SPAN [m]	Wall HEIGHT [m]	FILL HEIGHT, H_f [m]	TOP SLAB THICKNESS,T1 [mm]	WALL THICKNESS, W [mm]	BOTTOM SLAB REINFORCEMENT										TOP SLAB REINFORCEMENT										EXTERIOR WALL INTERNAL REINFORCEMENT								QUANTITY PER METER WIDTH OF BARREL		FILL HEIGHT, H_f [m]	Wall HEIGHT [m]	CLEAR SPAN [m]
					BAR-S1					BAR-S3			BAR-S4			BAR-S6					BAR-S7			BAR-S8			BAR-S2				BAR-S5				CONCRETE [m^3]	REINFORCEMENT STEEL [KG]			
					Ø	Spacing [mm]	a [mm]	b [mm]	Length [mm]	Ø	Spacing [mm]	LENGTH [mm]	Ø	Spacing [mm]	Length [mm]	Ø	Spacing [mm]	a [mm]	b [mm]	Length [mm]	Ø	Spacing [mm]	LENGTH [mm]	Ø	Spacing [mm]	Length [mm]	Ø	Spacing [mm]	c [mm]	Length [mm]	Ø	Spacing [mm]	d [mm]	Length [mm]					
4.00	2.00	H_f < 0.65	320	250	16	200	2440	1510	3950	16	280	4400	16	280	3190	16	160	2440	1510	3950	20	360	4400	20	360	3190	12	170	560	860	12	170	2270	2570	4.06	318.89	H_f < 0.65		
		0.65 <=H_f < 1.20	280	250	16	170	2440	1470	3910	20	400	4400	20	400	3190	16	140	2440	1470	3910	20	360	4400	20	360	3190	12	320	520	820	12	320	2230	2530	3.69	326.15	0.65 <=H_f < 1.20		
		1.20 <=H_f < 2.20	300	250	16	150	2440	1490	3930	20	340	4400	20	340	3190	16	140	2440	1490	3930	20	340	4400	20	340	3190	12	320	540	840	12	320	2250	2550	3.88	348.25	1.20 <=H_f < 2.20		
		2.20 <=H_f < 3.20	360	250	20	230	2500	1610	4110	20	280	4400	20	280	3190	16	130	2500	1610	4110	20	300	4400	20	300	3190	12	320	600	900	12	320	2310	2610	4.43	384.68	2.20 <=H_f < 3.20		
		3.20 <=H_f < 4.20	420	270	20	220	2520	1670	4190	24	420	4400	24	420	3210	16	130	2520	1670	4190	24	440	4400	24	440	3210	12	290	660	960	12	290	2370	2670	5.10	392.05	3.20 <=H_f < 4.20		
		4.20 <=H_f < 5.20	480	270	20	230	2520	1730	4250	24	400	4400	24	400	3210	16	140	2520	1730	4250	24	400	4400	24	400	3210	12	290	720	1020	12	290	2430	2730	5.65	393.43	4.20 <=H_f < 5.20		
		5.20 <=H_f < 6.20	550	270	20	220	2520	1800	4320	24	360	4400	24	360	3210	16	130	2520	1800	4320	24	360	4400	24	360	3210	12	290	790	1090	12	290	2500	2800	6.30	424.09	5.20 <=H_f < 6.20		
		6.20 <=H_f < 7.20	620	300	20	220	2550	1870	4420	24	340	4400	24	340	3230	20	200	2550	1870	4420	24	340	4400	24	340	3230	12	260	860	1160	12	260	2570	2870	7.15	443.93	6.20 <=H_f < 7.20		
		7.20 <=H_f < 8.00	700	300	20	200	2550	1950	4500	24	320	4400	24	320	3230	20	200	2550	1950	4500	24	320	4400	24	320	3230	12	260	940	1240	12	260	2650	2950	7.90	468.85	7.20 <=H_f < 8.00		
	3.00	H_f < 0.65	320	250	16	180	2440	2010	4450	20	420	4400	20	420	3190	16	160	2440	2010	4450	20	340	4400	20	340	3190	12	170	560	860	12	170	3270	3570	4.56	359.74	H_f < 0.65		
		0.65 <=H_f < 1.20	290	250	16	160	2440	1980	4420	20	360	4400	20	360	3190	16	150	2440	1980	4420	20	340	4400	20	340	3190	12	170	530	830	12	170	3240	3540	4.29	380.93	0.65 <=H_f < 1.20		
		1.20 <=H_f < 2.20	330	250	20	220	2500	2080	4580	20	340	4400	20	340	3190	16	140	2500	2080	4580	20	340	4400	20	340	3190	12	170	570	870	12	170	3280	3580	4.65	410.56	1.20 <=H_f < 2.20		
		2.20 <=H_f < 3.20	360	250	20	190	2500	2110	4610	20	280	4400	20	280	3190	20	190	2500	2110	4610	20	300	4400	20	300	3190	12	320	600	900	12	320	3310	3610	4.93	441.65	2.20 <=H_f < 3.20		
		3.20 <=H_f < 4.20	430	270	20	200	2520	2180	4700	20	280	4400	20	280	3210	20	200	2520	2180	4700	20	280	4400	20	280	3210	12	290	670	970	12	290	3380	3680	5.73	442.73	3.20 <=H_f < 4.20		
		4.20 <=H_f < 5.20	480	270	20	180	2520	2230	4750	24	400	4400	24	400	3210	20	180	2520	2230	4750	24	400	4400	24	400	3210	12	160	720	1020	12	160	3430	3730	6.19	496.56	4.20 <=H_f < 5.20		
		5.20 <=H_f < 6.20	550	300	20	170	2550	2300	4850	24	360	4400	24	360	3230	20	170	2550	2300	4850	24	380	4400	24	380	3230	12	150	790	1090	12	150	3500	3800	7.09	534.83	5.20 <=H_f < 6.20		
		6.20 <=H_f < 7.20	620	300	20	160	2550	2370	4920	24	340	4400	24	340	3230	20	160	2550	2370	4920	24	340	4400	24	340	3230	12	150	860	1160	12	150	3570	3870	7.75	571.22	6.20 <=H_f < 7.20		
		7.20 <=H_f < 8.00	690	340	20	150	2590	2440	5030	24	320	4400	24	320	3260	20	160	2590	2440	5030	24	320	4400	24	320	3260	16	240	1030	1330	16	240	3640	3940	8.76	609.45	7.20 <=H_f < 8.00		
	4.00	H_f < **0.65**	320	250	20	220	2500	2570	5070	20	420	4400	20	420	3190	16	140	2500	2570	5070	20	340	4400	20	340	3190	12	170	560	860	12	170	4270	4570	5.06	432.35	H_f < 0.65		
		0.65 <=H_f < 1.20	300	250	20	190	2500	2550	5050	20	380	4400	20	380	3190	16	130	2500	2550	5050	20	360	4400	20	360	3190	12	170	540	840	12	170	4250	4550	4.88	459.31	0.65 <=H_f < 1.20		
		1.20 <=H_f < 2.20	330	250	20	160	2500	2580	5080	20	340	4400	20	340	3190	20	180	2500	2580	5080	20	360	4400	20	360	3190	12	170	570	870	12	170	4280	4580	5.15	507.82	1.20 <=H_f < 2.20		
		2.20 <=H_f < 3.20	370	270	20	150	2520	2620	5140	20	300	4400	20	300	3210	20	160	2520	2620	5140	20	320	4400	20	320	3210	12	160	610	910	12	160	4320	4620	5.71	558.45	2.20 <=H_f < 3.20		
		3.20 <=H_f < 4.20	440	270	20	140	2520	2690	5210	20	300	4400	20	300	3210	20	150	2520	2690	5210	20	320	4400	20	320	3210	12	160	680	980	12	160	4390	4690	6.36	587.42	3.20 <=H_f < 4.20		
		4.20 <=H_f < 5.20	490	300	24	220	2610	2800	5410	24	420	4400	24	420	3230	20	140	2610	2800	5410	24	440	4400	24	440	3230	12	150	730	1030	12	150	4440	4740	7.13	608.61	4.20 <=H_f < 5.20		
		5.20 <=H_f < 6.20	560	320	24	210	2630	2870	5500	24	380	4400	24	380	3240	20	130	2630	2870	5500	24	400	4400	24	400	3240	12	140	800	1100	12	140	4510	4810	7.99	658.20	5.20 <=H_f < 6.20		
		6.20 <=H_f < 7.20	630	350	24	200	2660	2940	5600	24	360	4400	24	360	3270	20	130	2660	2940	5600	24	380	4400	24	380	3270	16	240	970	1270	16	240	4580	4880	8.97	689.43	6.20 <=H_f < 7.20		
		7.20 <=H_f < 8.00	700	370	24	190	2680	3010	5690	24	340	4400	24	340	3280	20	120	2680	3010	5690	24	340	4400	24	340	3280	16	220	1040	1340	16	220	4650	4950	9.86	747.49	7.20 <=H_f < 8.00		

*All longitudinal bars are included in the quantity.

NOTE:-

- Lap splice at the midspan of slab or wall is in compression and is taken to be 30 times bar diameter with a 300 mm minimum.
- Headwall and cutoff wall quantity is not included in the table above.





TYPICAL SECTION

GENERAL NOTES:

Manual used: The prevailing version of the ERA Bridge Design Manual

Loading used: HL-93 Load

All dimensions are in millimeters.

All bend dimensions are out to out of bar.

All reinforcing steel shall have the specified clear cover.

Joint Notes:

All structures shall have formed construction joints in top slab and walls (optional in floor slab) spaced not more than 12m. Apart or as shown, reinforcing steel shall project 500 mm. thru. the joint.

Material (Strength) Properties:

Concrete: The minimum cylinderical compressive strength at 28 days shall be 20MPa.

Reinforcement Steel: The minimum yield strength of deformed bar shall be 500 MPa in accordance with the prevailing version of the ERA Bridge Design Manual.
Overlap for the longitudinal reinf. Ø12-300mm.
For class os finish refer to Technical Specification.

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

REVISIONS

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
ETHIOPIAN ROADS AUTHORITY
Post Office Box 1770 Addis Ababa Ethiopia
Cable Address Highways Addis Ababa
Telex 21180 Tel.No. 51-71-70/79

BOX CULVERT SINGLE 4m CLEAR SPAN, 2-4m WALL HEIGHT AND FILL 0-8m

DRAWN		SCALE: 1:50 (at A3)	DRAWING NUMBER C-03
DESIGNED			
CHECKED		DATE: December 2011	
APPROVED	B. JEBESSA		
EDITED	S. KIRSTEN		

| CLEAR SPAN [m] | Wall HEIGHT [m] | FILL HEIGHT, H, [m] | TOP SLAB THICKNESS T1, [mm] | WALL THICKNESS W [mm] | BOTTOM SLAB REINFORCEMENT | | | | | | | | | | | | | | TOP SLAB REINFORCEMENT | | | | | | | | | | | | | | | | | EXTERIOR WALL INTERNAL REINFORCEMENT | | | | | | | | | | INTERIOR WALL EACH FACE REINFORCEMENT | | | | | | | | | | | | QUANTITY PER METER WIDTH OF BARREL | | FILL HEIGHT, H, [m] | Wall HEIGHT [m] | CLEAR SPAN [m] |
|---|---|---

| CLEAR SPAN [m] | Wall HEIGHT [m] | FILL HEIGHT, H [m] | TOP SLAB THICKNESS T1 [mm] | WALL THICKNESS W [mm] | BOTTOM SLAB REINFORCEMENT | | | | | | | | | | | | | | | | TOP SLAB REINFORCEMENT | | | | | | | | | | | | | | | | | | | | | | EXTERIOR WALL INTERNAL REINFORCEMENT | | | | INTERIOR WALL EACH FACE REINFORCEMENT | | | | | | | | | | | | QUANTITY PER METER WIDTH OF BARREL | | FILL HEIGHT, H [m] | Wall HEIGHT [m] | CLEAR SPAN [m] |
|---|---|---

TABLE-1 SLAB THICKNESS, BAR SCHEDULE AND QUANTITY PER METER WIDTH OF CULVERT

CLEAR SPAN [m]	H_F <= 0.6m						0.6 < H_F <= 1.20m						1.20 < H_F <= 2.20m						2.20 < H_F <= 3.20m						3.20 < H_F <= 4.20m						4.20 < H_F <= 5.20m						5.20 < H_F <= 6.20m						6.20 < H_F <= 7.20m						7.20 < H_F <= 8.20m						CLEAR SPAN [m]
	D_S SLAB THICHNESS [mm]	BAR "S1"			QUANTITY PER METER WIDTH		D_S SLAB THICKNESS [mm]	BAR "S1"			QUANTITY PER METER WIDTH		D_S SLAB THICKNESS [mm]	BAR "S1"			QUANTITY PER METER WIDTH		D_S SLAB THICKNESS [mm]	BAR "S1"			QUANTITY PER METER WIDTH		D_S SLAB THICKNESS [mm]	BAR "S1"			QUANTITY PER METER WIDTH		D_S SLAB THICKNESS [mm]	BAR "S1"			QUANTITY PER METER WIDTH		D_S SLAB THICKNESS [mm]	BAR "S1"			QUANTITY PER METER WIDTH		D_S SLAB THICKNESS [mm]	BAR "S1"			QUANTITY PER METER WIDTH								
		BAR SIZE [mm]	SPACING [mm]	LENGTH [mm]	CONCRETE [m^3]	REINFORCEMENT STEEL [kg]		BAR SIZE [mm]	SPACING [mm]	LENGTH [mm]	CONCRETE [m^3]	REINFORCEMENT STEEL [kg]		BAR SIZE [mm]	SPACING [mm]	LENGTH [mm]	CONCRETE [m^3]	REINFORCEMENT STEEL [kg]		BAR SIZE [mm]	SPACING [mm]	LENGTH [mm]	CONCRETE [m^3]	REINFORCEMENT STEEL [kg]		BAR SIZE [mm]	SPACING [mm]	LENGTH [mm]	CONCRETE [m^3]	REINFORCEMENT STEEL [kg]		BAR SIZE [mm]	SPACING [mm]	LENGTH [mm]	CONCRETE [m^3]	REINFORCEMENT STEEL [kg]		BAR SIZE [mm]	SPACING [mm]	LENGTH [mm]	CONCRETE [m^3]	REINFORCEMENT STEEL [kg]		BAR SIZE [mm]	SPACING [mm]	LENGTH [mm]	CONCRETE [m^3]	REINFORCEMENT STEEL [kg]							
1.00	200	16	220	1900	0.36	19.94	200	12	180	1680	0.36	11.82	200	12	230	1680	0.36	10.02	200	12	200	1680	0.36	10.99	200	12	160	1680	0.36	12.85	200	12	140	1680	0.36	14.18	200	16	200	1790	0.36	19.22	200	16	160	1790	0.36	21.17	1.00
2.00	220	20	220	2930	0.62	43.85	220	16	150	2640	0.62	34.00	220	16	150	2640	0.62	30.73	220	20	190	2750	0.62	35.71	220	20	160	2750	0.62	41.92	230	20	140	2750	0.64	46.12	240	24	210	2870	0.67	46.85	260	24	200	2870	0.73	48.55	270	24	190	2870	0.76	52.39	2.00
3.00	260	20	190	3870	0.99	64.37	260	20	150	3630	0.99	67.56	260	20	130	3610	0.99	76.36	270	24	190	3720	1.03	77.42	280	24	170	3720	1.06	85.59	310	24	160	3720	1.18	90.44	330	24	150	3720	1.25	95.93	350	24	140	3720	1.33	102.21	360	24	130	3720	1.37	109.46	3.00
4.00	300	20	170	4780	1.44	88.18	300	24	200	4650	1.44	93.08	310	24	160	4570	1.49	112.05	330	24	140	4570	1.58	126.53	360	24	130	4570	1.73	135.45	390	30	190	4800	1.87	149.89	420	30	180	4800	2.02	157.67	440	30	160	4800	2.11	176.16	470	30	160	4800	2.26	176.16	4.00
5.00	340	20	140	5670	1.97	123.42	470	24	160	5570	1.97	136.02	370	30	200	5650	2.15	169.22	400	30	180	5660	2.32	186.65	440	30	170	5660	2.55	196.90	470	30	150	5660	2.73	221.50	500	30	140	5670	2.90	236.83	530	32	150	5720	3.07	254.07	560	32	140	5750	3.25	272.62	5.00
6.00	380	24	200	6660	2.58	145.04	380	24	140	6480	2.58	179.29	440	30	170	6510	2.99	226.51	480	30	150	6510	3.26	254.85	520	30	140	6540	3.54	273.23	560	32	150	6610	3.81	293.93	600	32	140	6650	4.08	316.48	630	32	130	6680	4.28	341.87	700	32	130	6750	4.76	347.04	6.00

Table-2..EDGE BEAM QUANTITIES PER CULVERT

CLEAR SPAN [m]	H_F <= 0.6m				0.6 < H_F<=1.20m		1.20 < H_F<= 2.20m		2.20 < H_F<= 3.20m		3.20 < H_F<= 4.20m		4.20 < H_F<= 5.20m		5.20 < H_F<= 6.20m		6.20 < H_F<= 7.20m		7.20 < H_F<= 8.20m		CLEAR SPAN [m]
	CONCRETE [m^3]	REINFORCEMENT STEEL [kg]	BAR "B3"		CONCRETE [m^3]	REINFORCEMENT STEEL [kg]	CONCRETE [m^3]	REINFORCEMENT STEEL [kg]	CONCRETE [m^3]	REINFORCEMENT STEEL [kg]	CONCRETE [m^3]	REINFORCEMENT STEEL [kg]	CONCRETE [m^3]	REINFORCEMENT STEEL [kg]	CONCRETE [m^3]	REINFORCEMENT STEEL [kg]	CONCRETE [m^3]	REINFORCEMENT STEEL [kg]	CONCRETE [m^3]	REINFORCEMENT STEEL [kg]	
			BAR SIZE [mm]	NUMBER OF BAR PER EDGE BEAM																	
1.00	0.45	44.75	20	3	0.26	33.16	0.26	33.16	0.26	33.16	0.26	33.16	0.26	33.16	0.26	33.16	0.26	33.16	0.26	33.16	1.00
2.00	0.74	87.20	24	3	0.43	51.50	0.43	51.50	0.43	51.50	0.43	51.50	0.44	51.86	0.45	52.21	0.46	52.92	0.47	53.28	2.00
3.00	1.10	119.93	24	3	0.63	71.20	0.63	71.20	0.64	71.66	0.66	72.13	0.70	73.51	0.72	74.43	0.75	75.36	0.76	75.82	3.00
4.00	1.51	189.20	24	4	0.86	93.78	0.88	94.38	0.91	95.59	0.96	97.40	1.02	99.21	1.07	101.02	1.10	102.23	1.15	90.39	4.00
5.00	1.98	230.88	24	4	1.13	115.32	1.19	117.45	1.25	119.58	1.33	122.43	1.39	124.56	1.45	126.69	1.51	128.82	1.57	130.95	5.00
6.00	2.50	255.32	24	4	1.41	137.72	1.56	142.62	1.65	145.89	1.75	149.16	1.84	152.42	1.94	155.69	2.01	158.14	2.18	163.86	6.00

NOTE :

- SPECIAL CURB AND RAILING DETAIL SHALL BE DESIGNED FOR AT GRADE CULVERTS.
- AS MUCH AS POSSIBLE, IT IS ECONOMICALLY RECOMMENDABLE TO USE TWO BY 3m. SLAB CULVERTS RATHER THAN ONE 6m. SLAB CULVERT.
- FOR CULVERTS WITH FILL HEIGHT GREATER THAN 0.60m, PROVIDE 2 Ø12-B3.
- FOR CULVERTS WITH FILL HEIGHT LESS THAN OR EQUAL TO 0.60m, PROVIDE THE NUMBER AND DIAMETER OF BAR B3 GIVEN IN TABLE-2 IN ADDITION TO THE MAIN REINFORCEMENT, BAR S1, GIVEN IN TABLE-1.

LEGEND

D_S- TOP SLAB THICKNESS
HF - HEIGHT OF FILL
b - WIDTH OF SLAB (LENGTH OF ABUTMENT)
RDWY- ROAD WAY WIDTH
Sb - BED SLOPE
S - CLEAR SPAN LENGTH

GENERAL NOTES:

Manual used: The prevailing version of the ERA Bridge Design Manual

Loading used: HL-93 Load

All dimensions are in millimeters.

All bend dimensions are out to out of bar.

All reinforcing steel shall have the specified clear cover.

Joint Notes:

All structures shall have formed construction joints in top slab and walls (optional in floor slab) spaced not more than 12m.

apart or as shown, reinforcing steel shall project 500 mm. thru. the joint.

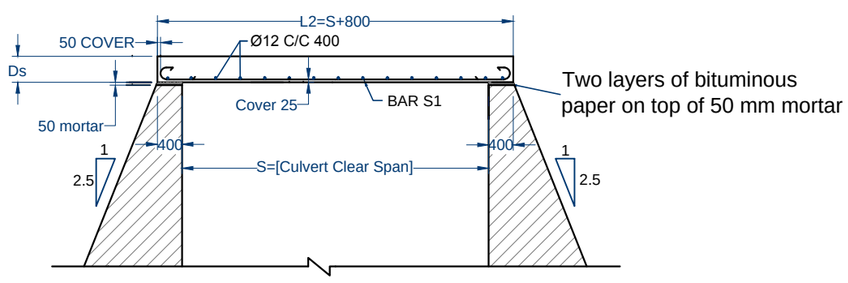
Material (Strength) Properties:

Concrete: The minimum cylindrical compressive strength at 28 days shall be 20MPa.

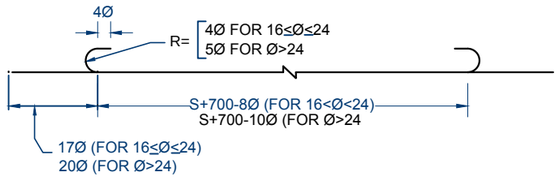
Reinforcement Steel: The minimum yield strength of deformed bar shall be 500 MPa in accordance with the prevailing version of the ERA Bridge Design Manual.

Overlap for the longitudinal reinf. Ø12-300mm.

For class os finish refer to Technical Specification.

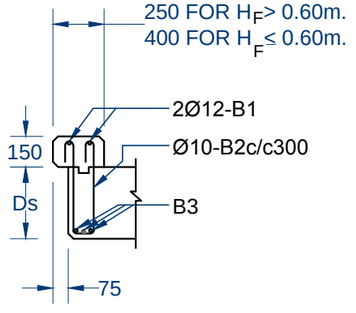


LONGITUDINAL SECTION (Scale 1:100)

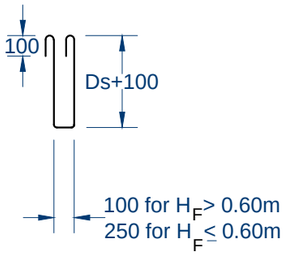


*WHERE R IS THE OUTER BAR RADIUS.

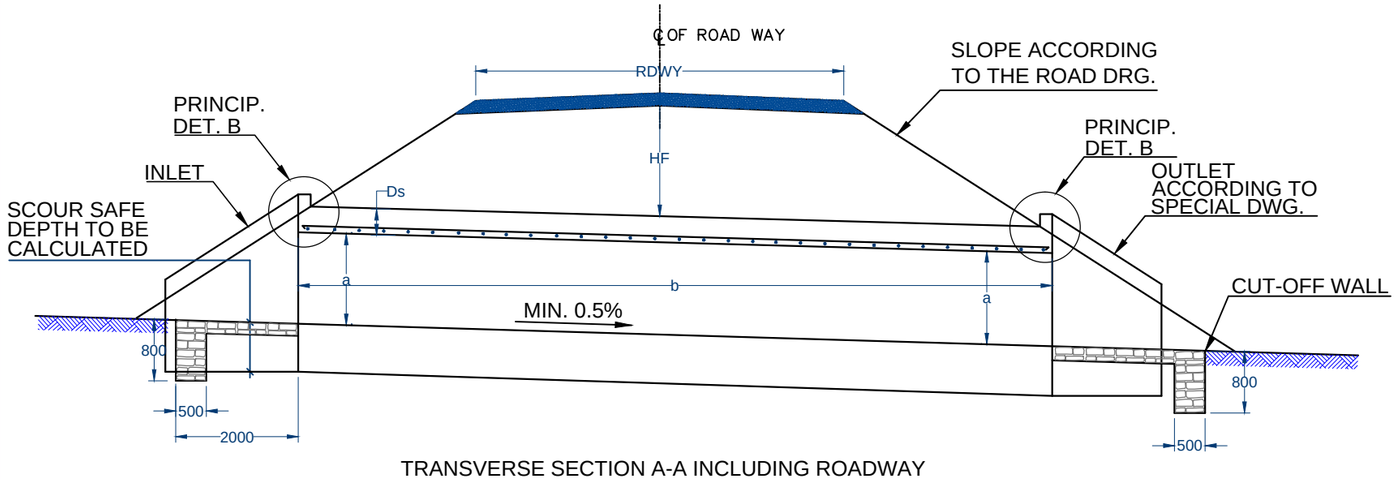
BAR-S1
Scale 1:50



EDGE BEAM DETAIL B (Scale 1:50)
* Where Ds is Top Slab Thickness



BAR-B2
Scale 1:50



TRANSVERSE SECTION A-A INCLUDING ROADWAY
Scale 1:100

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

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ETHIOPIAN ROADS AUTHORITY
Post Office Box 1770 Addis Ababa Ethiopia
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Telex 21180 Tel.No. 51-71-70/79

SLAB CULVERT SINGLE 1-6 m CLEAR SPAN; AND FILL < 8.2 m

DRAWN		SCALE: As shown (at A3)	DRAWING NUMBER
DESIGNED			C-06
CHECKED			
APPROVED	B. JEBESSA	DATE: December 2011	
EDITED	S. KIRSTEN		

Table-1. SLAB THICKNESS, BAR SCHEDULE AND QUANTITY PER METER WIDTH OF CULVERT

CLEAR SPAN [m]	H_F < 1.0m															H_F < 3.0m															H_F < 6.0m													
	Ds, SLAB THICKNESS [mm]	BAR "S1"			BAR "S2"			BAR "S3"			BAR "S4"				QUANTITY PER METER WIDTH		BAR "S1"			BAR "S2"			BAR "S3"			BAR "S4"				QUANTITY PER METER WIDTH		BAR "S1"			BAR "S2"			BAR "S3"			BAR "S4"				QUANTITY PER METER WIDTH	
		BAR SIZE [mm]	BAR SPACING [mm]	LENGTH [mm]	BAR SIZE [mm]	BAR SPACING [mm]	LENGTH [mm]	BAR SIZE [mm]	BAR SPACING [mm]	LENGTH [mm]	BAR SIZE [mm]	BAR SPACING [mm]	LENGTH [mm]	NO. OF BARS	CONCRETE [m^3]	REINFORCEMENT STEEL [kg]	Ds, SLAB THICKNESS [mm]	BAR SIZE [mm]	BAR SPACING [mm]	LENGTH [mm]	BAR SIZE [mm]	BAR SPACING [mm]	LENGTH [mm]	BAR SIZE [mm]	BAR SPACING [mm]	LENGTH [mm]	BAR SIZE [mm]	BAR SPACING [mm]	LENGTH [mm]	NO. OF BARS	CONCRETE [m^3]	REINFORCEMENT STEEL [kg]	Ds, SLAB THICKNESS [mm]	BAR SIZE [mm]	BAR SPACING [mm]	LENGTH [mm]	BAR SIZE [mm]	BAR SPACING [mm]	LENGTH [mm]	BAR SIZE [mm]	BAR SPACING [mm]	LENGTH [mm]	BAR SIZE [mm]	BAR SPACING [mm]	LENGTH [mm]	NO. OF BARS	CONCRETE [m^3]	REINFORCEMENT STEEL [kg]
3.00	300	28	350	7120	24	320	4900	24	320	2020	12	400	1000	38	2.28	235.5	300	24	350	7070	24	360	3300	24	360	2020	12	400	1000	38	2.28	166	350	28	350	7120	28	340	3580	28	340	2500	12	400	1000	38	2.66	225.4
4.00	400	28	300	9120	28	380	7700	28	380	4030	12	400	1000	48	3.84	389.3	400	24	300	9070	24	320	4810	24	320	3210	12	400	1000	48	3.84	285.6	450	28	290	9120	28	300	5400	28	300	4030	12	400	1000	48	4.32	401.6
5.00	450	30	260	11150	28	280	8700	28	280	4240	12	400	1000	58	5.22	549.3	450	28	320	11120	28	340	6180	28	340	4240	12	400	1000	58	5.22	417.8	500	30	260	11150	30	260	6360	30	260	4700	12	400	1000	58	5.8	544.6
6.00	500	32	240	13180	28	340	9700	28	340	5080	12	400	1000	68	6.8	690.9	500	28	270	13120	28	280	6730	28	280	4860	12	400	1000	68	5.44	538.3	550	30	290	13150	30	300	6860	30	300	5350	12	400	1000	68	7.48	623.4

Table-2. EDGE BEAM QUANTITIES PER CULVERT

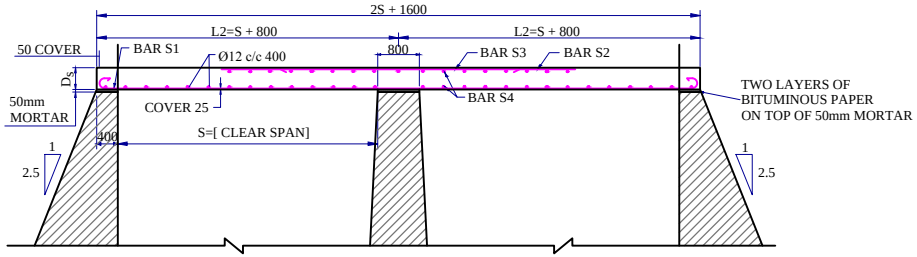
CLEAR SPAN [m]	H_F < 1.0m						H_F < 3.0m						H_F < 6.0m					
	BAR "B1"		BAR "B2"				BAR "B1"		BAR "B2"				BAR "B1"		BAR "B1"			
	BAR SIZE [mm]	NUMBER OF BAR PER EDGE BEAM	BAR SIZE [mm]	BAR SPACING [mm]	NUMBER OF BAR PER EDGE BEAM	CONCRETE [m^3]	REINFORCEMENT STEEL [kg]	BAR SIZE [mm]	NUMBER OF BAR PER EDGE BEAM	BAR SIZE [mm]	BAR SPACING [mm]	NUMBER OF BAR PER EDGE BEAM	CONCRETE [m^3]	REINFORCEMENT STEEL [kg]	BAR SIZE [mm]	NUMBER OF BAR PER EDGE BEAM	BAR SIZE [mm]	BAR SPACING [mm]	NUMBER OF BAR PER EDGE BEAM	CONCRETE [m^3]	REINFORCEMENT STEEL [kg]
3.00	24	4	10	300	26	1.71	259.4	24	4	10	300	26	1.71	259.4	24	4	10	300	26	1.90	262.6
4.00	24	4	10	300	32	2.64	334.6	24	4	10	300	32	2.64	334.6	24	4	10	300	32	2.88	338.5
5.00	24	4	10	300	39	3.48	410.0	24	4	10	300	39	3.48	410.0	24	4	10	300	39	3.77	414.8
6.00	24	4	10	300	46	4.42	487.1	24	4	10	300	46	3.74	475.8	24	4	10	300	46	4.76	492.8

NOTE

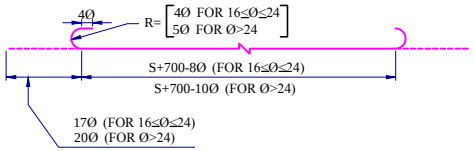
- SPECIAL CURB AND RAILING DETAIL SHALL BE DESIGNED FOR AT GRADE CULVERTS
- AS MUCH AS POSSIBLE, IT IS ECONOMICALLY RECOMMENDABLE TO USE TWO BY 3m. SLAB CULVERTS RATHER THAN ONE 6m. SLAB CULVERT.
- FOR CULVERTS WITH FILL HEIGHT GREATER THAN 0.6m, PROVIDE 2 Ø12-B3.
- FOR CULVERTS WITH FILL HEIGHT LESS THAN OR EQUAL TO 0.60m, PROVIDE THE NUMBER AND DIAMETER OF BAR B3 GIVEN IN TABLE 2 IN ADDITION TO THE MAIN REINFORCEMENT, BAR S1 GIVEN IN TABLE - 1

LEGEND

D_S - TOP SLAB THICKNESS
HF - HEIGHT OF WALL
b - WIDTH OF SLAB (LENGTH OF ABUTMENT)
RDWY- ROAD WAY WIDTH
Sb - BED SLOPE
S - CLEAR SPAN LENGTH

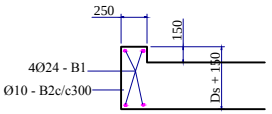


LONGITUDINAL SECTION (SCALE 1:50)



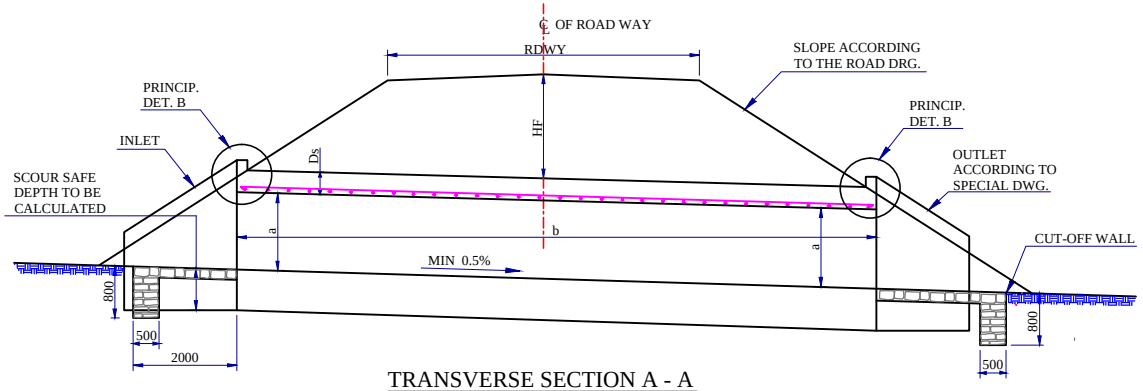
*WHERE R IS THE OUTER BAR RADIUS.

BAR - S1

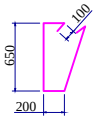


EDGE BEAM DETAIL B (SC. 1:25)

*WHERE Ds IS TOP SLAB THICKNESS



TRANSVERSE SECTION A - A



BAR - B2

GENERAL NOTES:

MANUALS USED-THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
LOADINGS USED :- HL-93 LOAD ACCORDING TO CHAPTER 3 OF THE ABOVE SPECIFICATIONS.
ALL DIMENSIONS ARE IN MILLIMETERS.

MATERIAL (STRENGTH) PROPERTIES:
CONCRETE :- THE MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS SHALL BE 20MPa (GRADE 2O).

REINFORCEMENT STEEL:- THE MINIMUM YIELD STRENGTH OF DEFORMED BAR SHALL BE 500MPa IN ACCORDANCE WITH ERA BRIDGE DESIGN MANUAL-2001

BEARING PRESSURE:- SUBSTRUCTURE HAS TO BE DESIGNED TO FIT THE ALLOWABLE BEARING CAPACITY OF THE FOUNDING MATERIAL.

FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION THE DESIGN FOR EDGE BEAMS IS DONE FOR 6m SPAN CULVERT.

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

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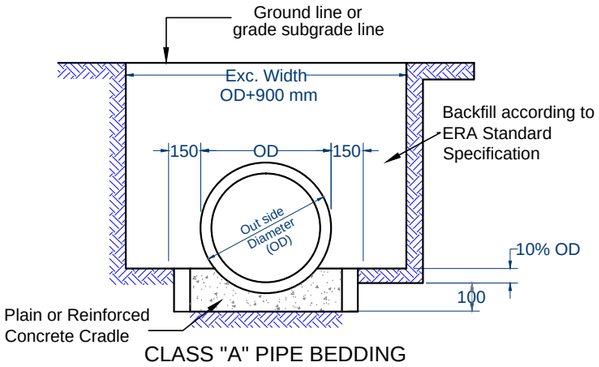
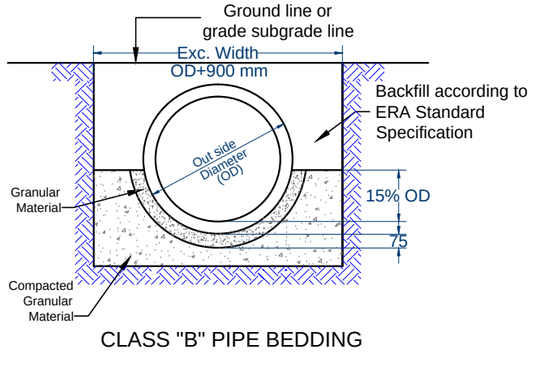
DOUBLE SLAB CULVERT 3–6m CLEAR SPAN; AND FILL HEIGHT < 6m.

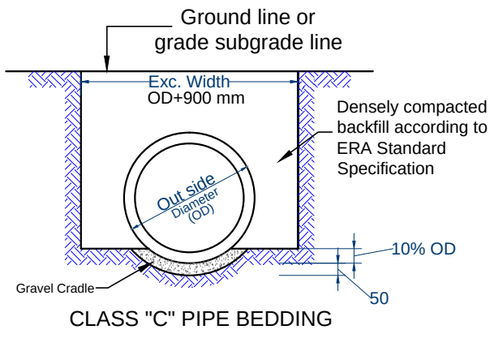
DRAWN	RAHEL	SCALE	DRG. NO.
DESIGNED	L.A.	AS SHOWN	
CHECKED	E.T.	DATE	C – 07
APPROVED	BEKELE JEBESSA	JAN/2003	
EDITED	STEPHEN KIRSTEN		



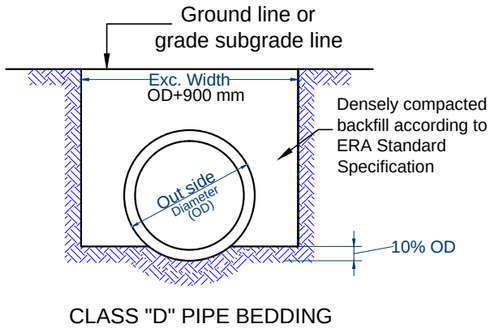
CLASS "A" PIPE BEDDING



CLASS "B" PIPE BEDDING

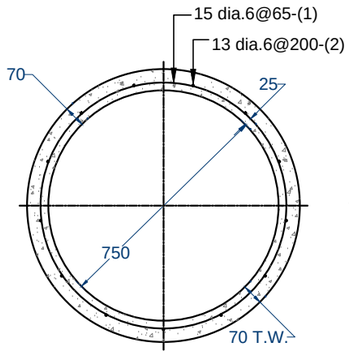


CLASS "C" PIPE BEDDING



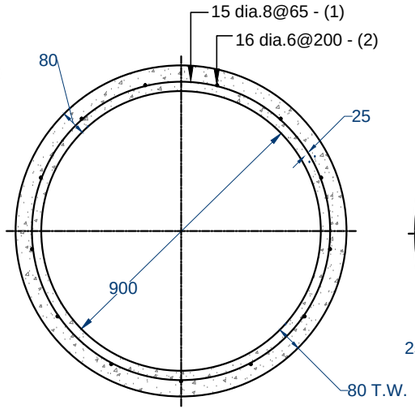
CLASS "D" PIPE BEDDING

DIA. 30"



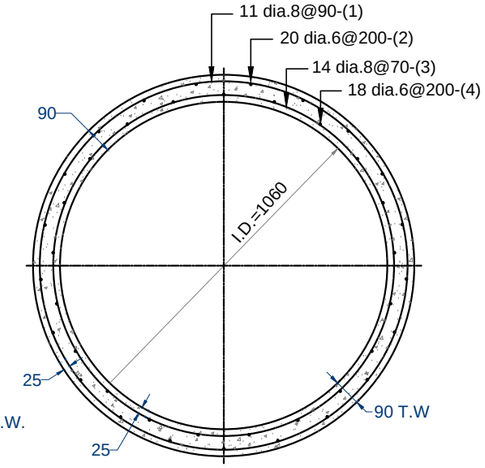
CROSS - SECTION
TYPE 1

DIA. 36"

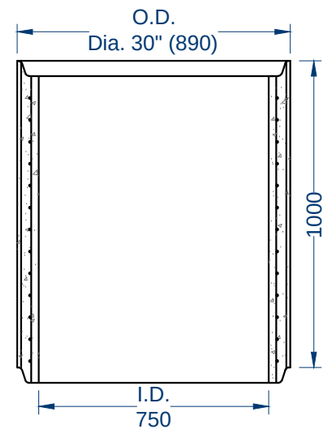


CROSS - SECTION
TYPE 2

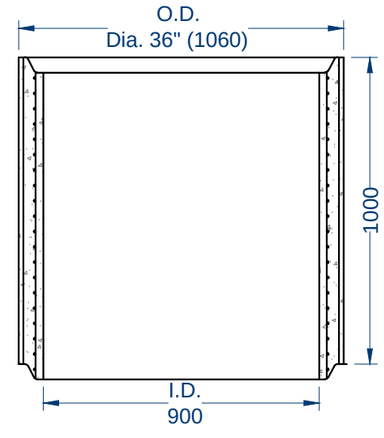
DIA. 42"



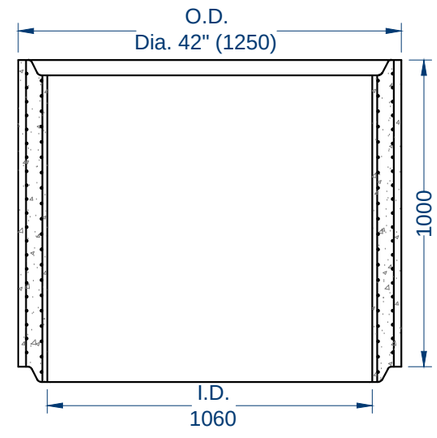
CROSS - SECTION
TYPE 3



LONGITUDINAL SECTION



LONGITUDINAL SECTION



LONGITUDINAL SECTION

GENERAL NOTE:
- Pipe shall either conform to ERA Technical Specifications and these drawings or conform to AASHTO Specification M-170
- CONCRETE Class C 30/20

TYPE 1							
I.D.				Bars 1			
mm	(IN)	O.D.	TW	No.	Size	Shape	Spacing
750	30	890	70	15	6	○	65
				13	6	——	200

BAR SCHEDULE

TYPE 2							
I.D.				Bars 2			
mm	(IN)	O.D.	TW	No.	Size	Shape	Spacing
900	36	1060	80	15	8	○	65
				16	6	——	200

BAR SCHEDULE

TYPE 3							
I.D. (IN)				Bars 3			
mm	(IN)	O.D.	TW	No.	Size	Shape	Spacing
1060	42	1250	90	11	8	○	90
				20	6	——	200
				14	8	○	70
				18	6	——	200

BAR SCHEDULE

NOTE:
All dimensions are in mm. unless noted
Minimum culvert size
recommended = 900 mm Dia.for main road

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

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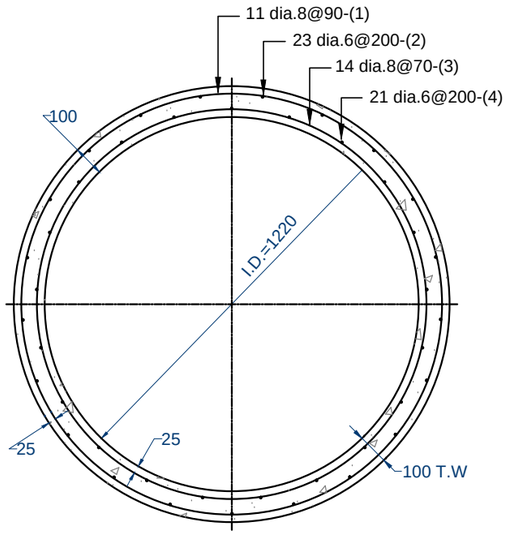
Telex 21180 Tel.No. 51-71-70/79

RC PIPE CULVERTS AND BEDDING

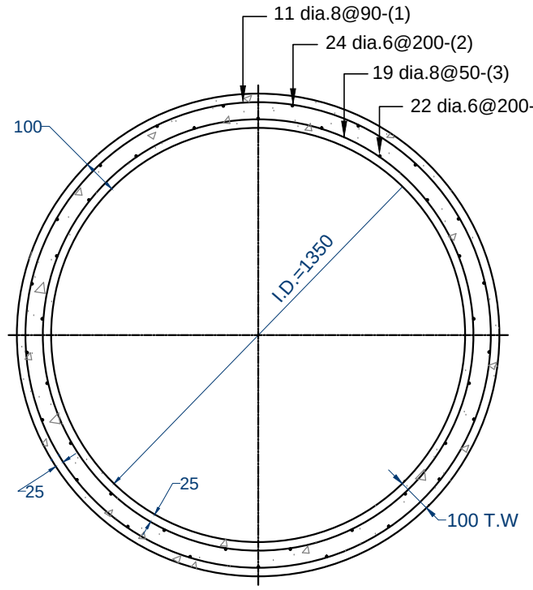
DRAWN		SCALE: 1:20 (at A3)	DRAWING NUMBER
DESIGNED			D-01A
CHECKED			
APPROVED	B. JEBESSA	DATE: December 2011	
EDITED	S. KIRSTEN		

DIA. 48"



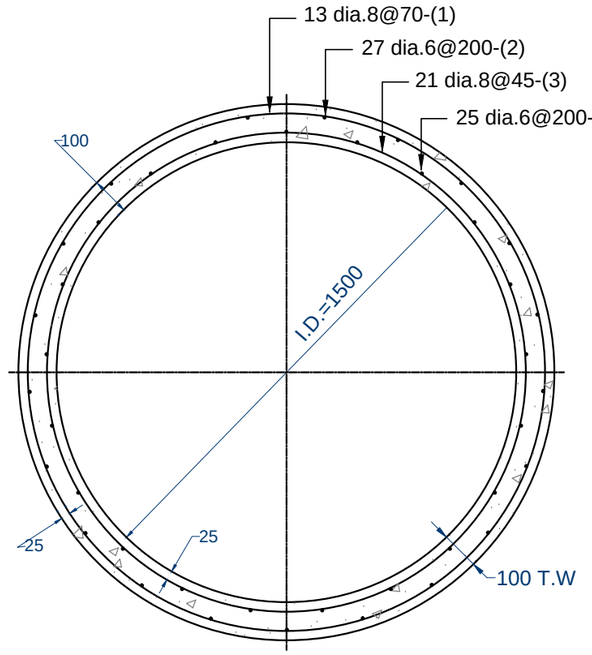
CROSS - SECTION
TYPE 4

DIA. 54"

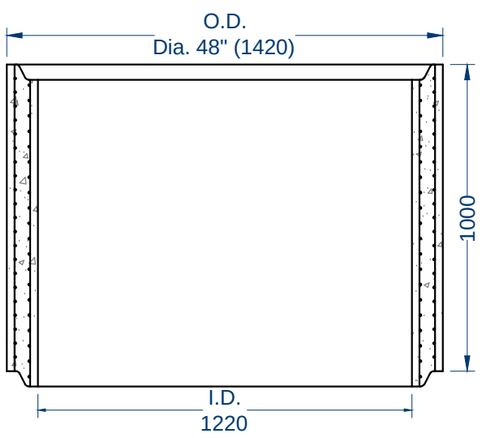


CROSS - SECTION
TYPE 5

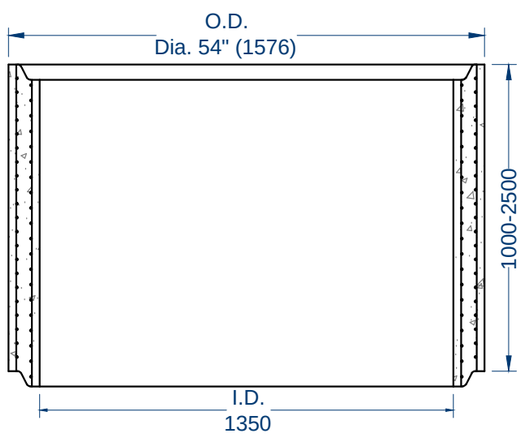
DIA. 60"



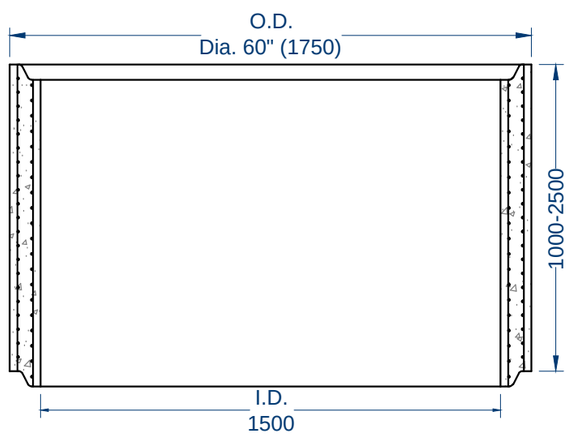
CROSS - SECTION
TYPE 6



LONGITUDINAL SECTION



LONGITUDINAL SECTION



LONGITUDINAL SECTION

TYPE 4							
I.D. (IN)				Bars 4			
mm	(IN)	O.D.	TW	No.	Size	Shape	Spacing
1220	48	1420	100	11	8	○	90
				23	6	—	200
				14	8	○	70
				21	6	—	200

BAR SCHEDULE

TYPE 5							
I.D. (IN)				Bars 4			
mm	(IN)	O.D.	TW	No.	Size	Shape	Spacing
1350	54	1576	113	11	8	○	90
				24	6	—	200
				19	8	○	50
				22	6	—	200

BAR SCHEDULE

TYPE 6							
I.D. (IN)				Bars 4			
mm	(IN)	O.D.	TW	No.	Size	Shape	Spacing
1500	60	1750	125	13	8	○	70
				27	6	—	200
				21	8	○	45
				25	6	—	200

BAR SCHEDULE

GENERAL NOTE:
-Pipe shall either conform to ERA Technical Specifications and these drawings or conform to AASHTO specifications M-170

-Concrete Class C 30/20

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

REVISIONS

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
ETHIOPIAN ROADS AUTHORITY
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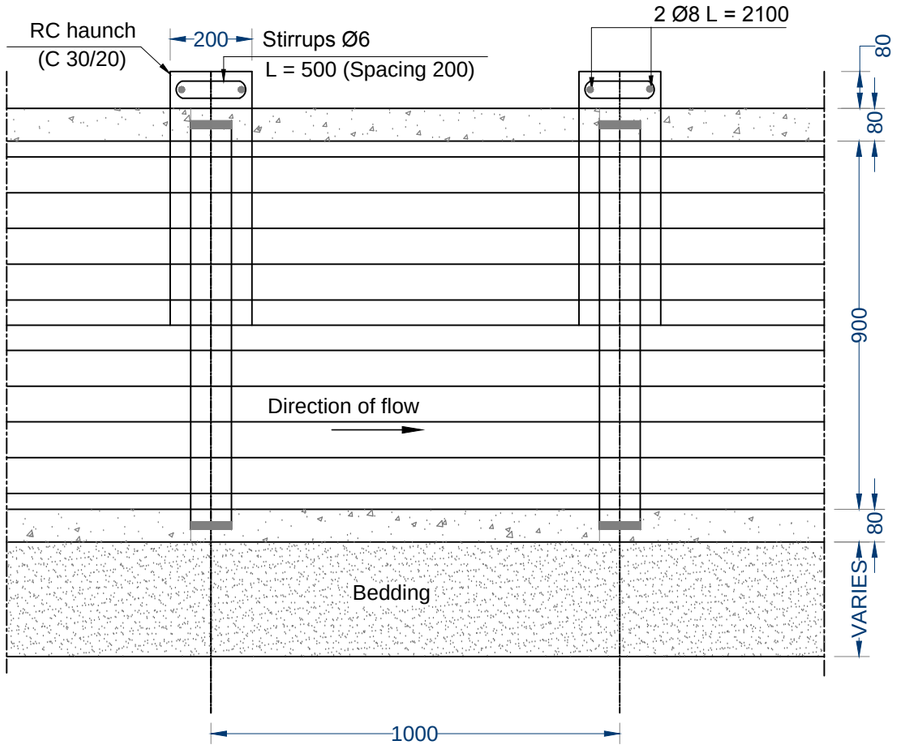
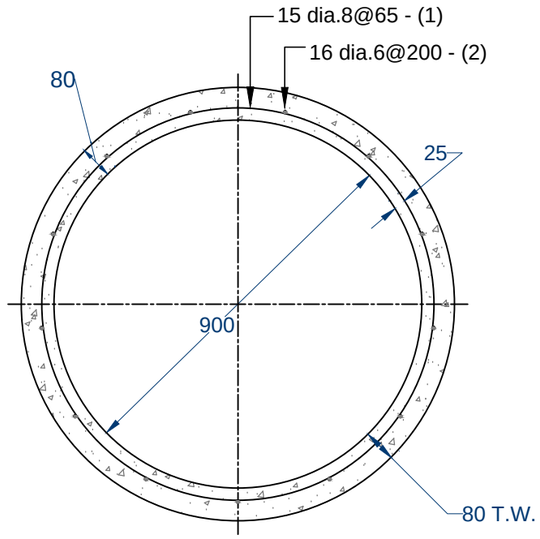
RC PIPE CULVERTS

DRAWN		SCALE: 1:20 (at A3)
DESIGNED		
CHECKED		
APPROVED	B. JEBESSA	DATE: December 2011
EDITED	S. KIRSTEN	

DRAWING NUMBER
D-01B

PIPE CULVERT DIA. 36"





CROSS - SECTION

TYPE 2

TYPE 2							
I.D.				Bars 2			
mm	(IN)	O.D.	TW	No.	Size	Shape	Spacing
900	36	1060	80	15	8	○	65
				16	6	——	200

BAR SCHEDULE

GENERAL NOTE:

- Pipe shall either conform to ERA Technical Specifications and these drawings or conform to AASHTO Specification M-170
- CONCRETE Class C 30/20

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
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A					

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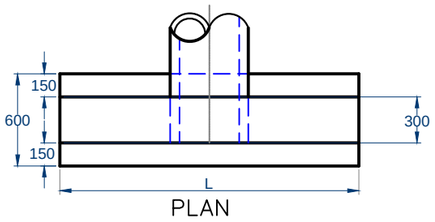
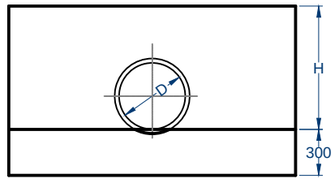
RC PIPE CULVERT CONNECTIVITY SAMPLE

DRAWN		SCALE: 1:15 (at A3)	DRAWING NUMBER
DESIGNED			D-01c
CHECKED			
APPROVED	B. JEBESSA	DATE: December 2011	
EDITED	S. KIRSTEN		



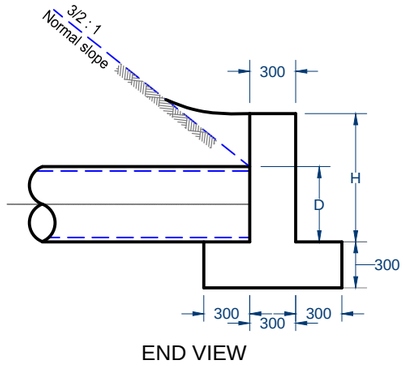
PLAN



SIDE VIEW

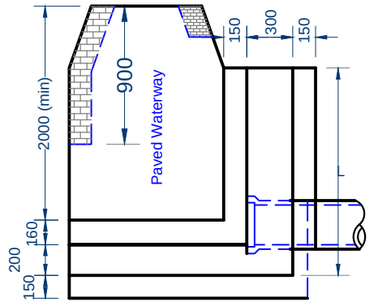
TYPE-A HEAD WALL

Concrete Class C 25/20 or
Masonry Class B

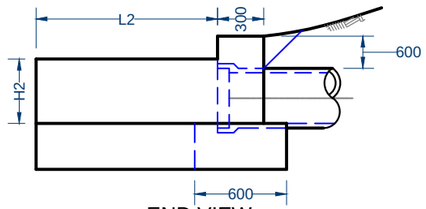


END VIEW

Scale 1:20



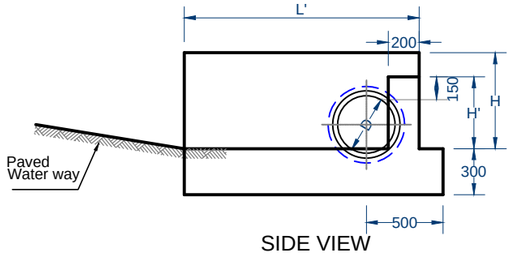
PLAN



END VIEW

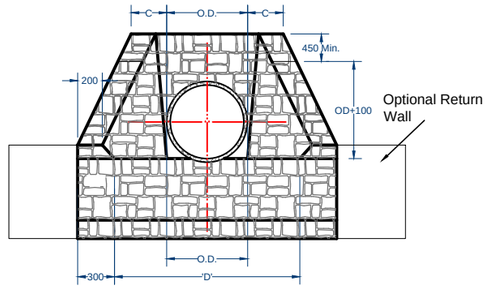
TYPE-B HEAD WALL

Concrete Class C 25/20 or
Masonry Class B
Scale 1:20



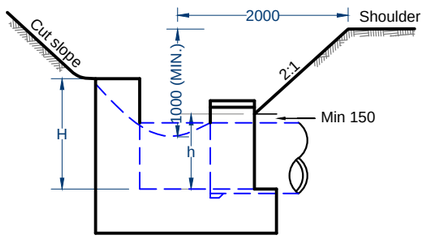
SIDE VIEW

Scale 1:20

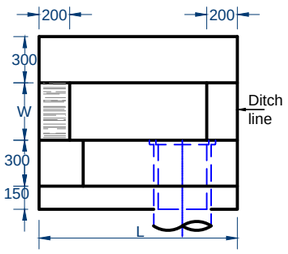


TYPE-C HEAD WALL

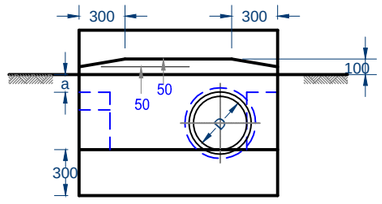
Scale 1:100



END VIEW



PLAN

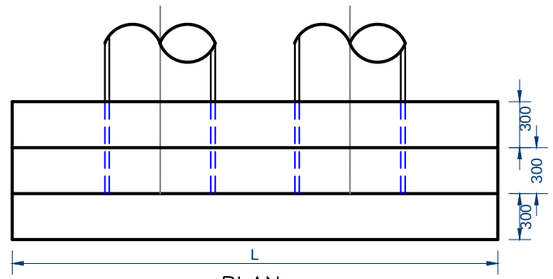


SIDE VIEW

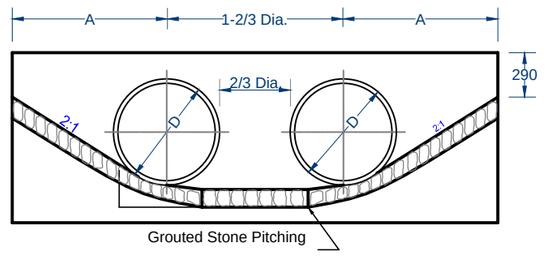
TYPE-A INLET

CLASS 20/20 CONCRETE

Scale 1:20



PLAN



SIDE VIEW

TYPE A-1 HEAD WALL

CLASS-B CONCRETE (Multiple pipes)

Scale 1:20

NOTE:- All dimensions are in millimeters unless otherwise shown
- For Class of finish refer to Technical Specifications
- Considering availability, masonry end wall may be used
- W=Bottom width of the approaching channel

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

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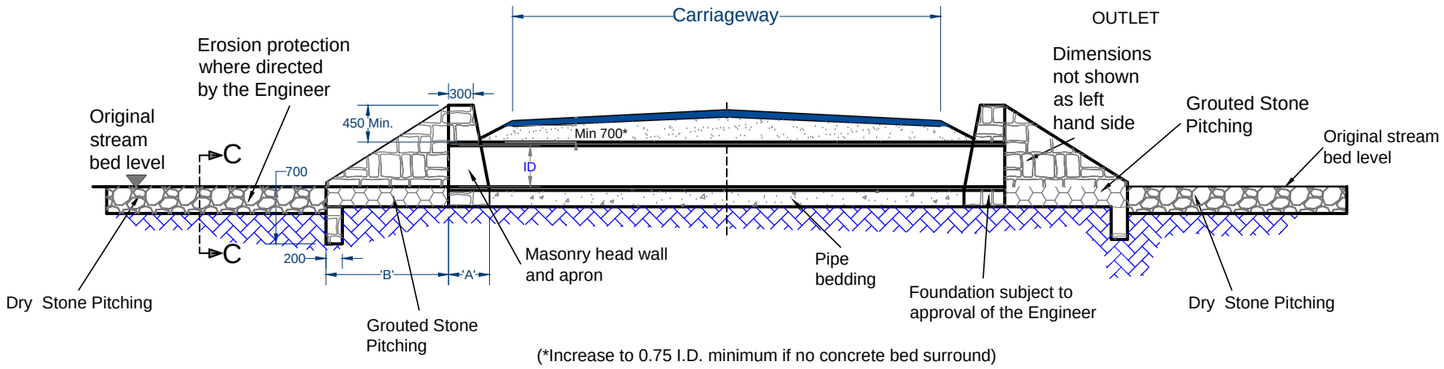
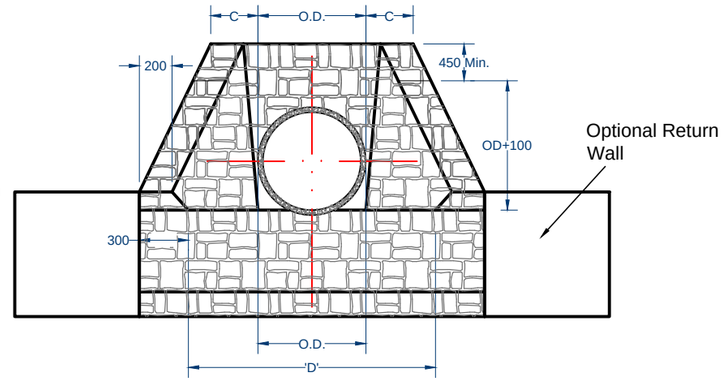
CULVERT HEADWALLS

DRAWN		SCALE:As shown(at A3)	DRAWING NUMBER
DESIGNED			D-02
CHECKED		DATE: December 2011	
APPROVED	B. JEBESSA		
EDITED	S. KIRSTEN		



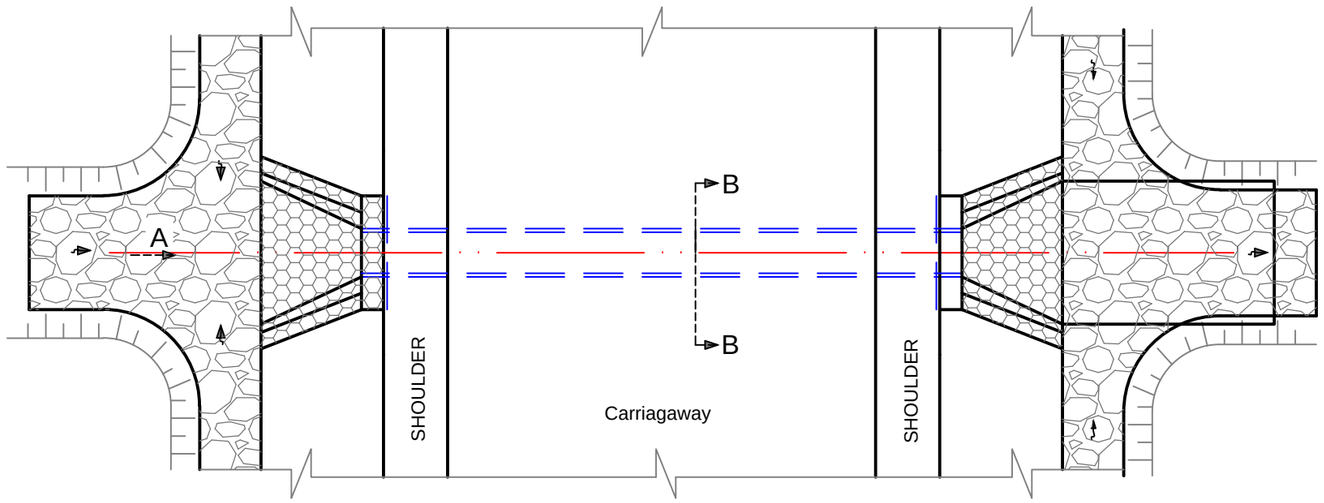
(*Increase to 0.75 I.D. minimum if no concrete bed surround)

LONGITUDNAL SECTION



END ELEVATION ON 'A'

HeadWall Type 'A'



PLAN VIEW

NOTES:
(1) All dimensions in mm.
(2) O.D.- Outside Diameter, I.D. - Inside Diameter.
(3) Section B-B shown on Drawing D-01A

KEY

- Concrete
- Masonry
- Dry Stone Pitching
- Firm foundation /Existing ground
- Road surface
- Grouted Stone Pitching

Table of dimension (mm)

PIPE DIAMETER	A	B	C	D
600	400	1350	400	2500
900	450	1800	500	3500
1200	500	2250	600	4100
1350	550	2475	700	4500
1520	600	2730	800	5000

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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B					
A					

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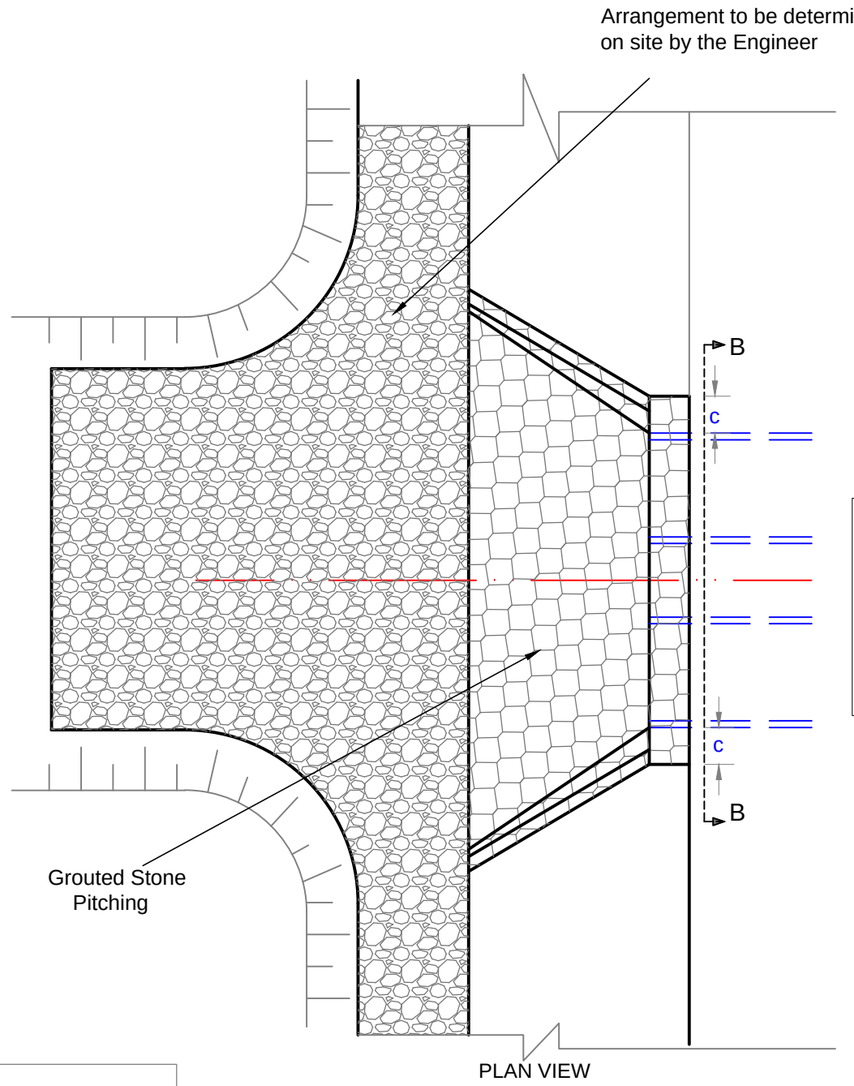
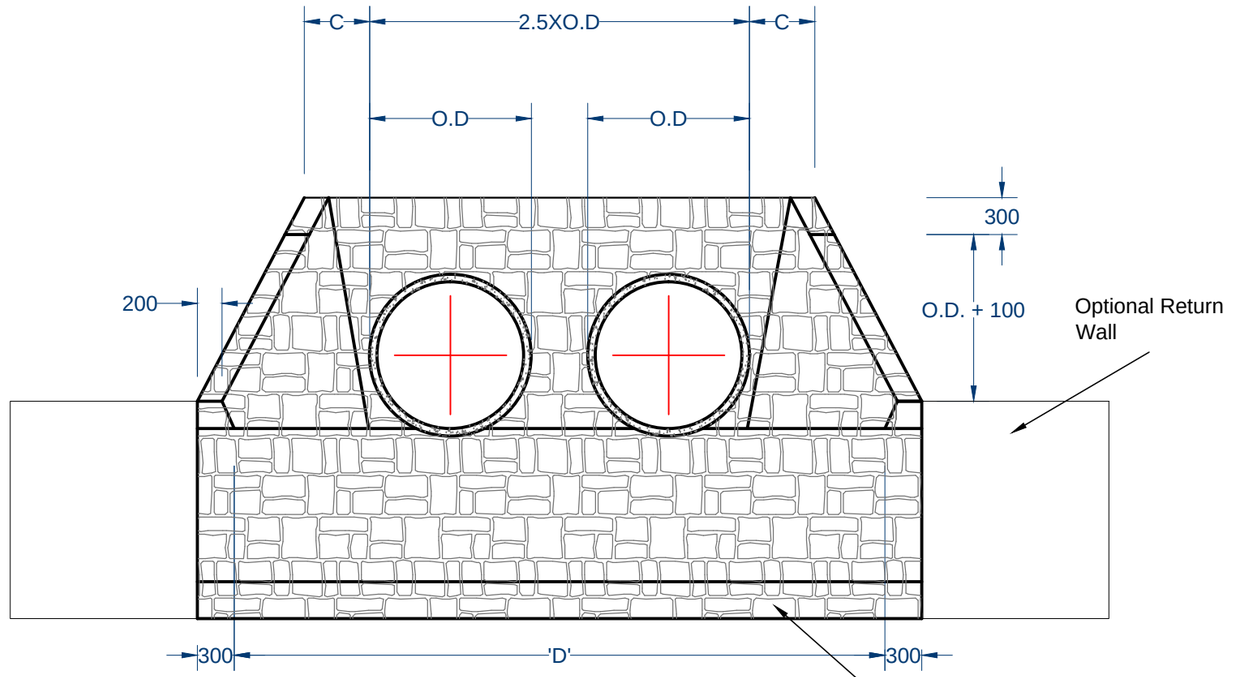
Single Pipe Culvert

General culvert design for relief and stream culverts

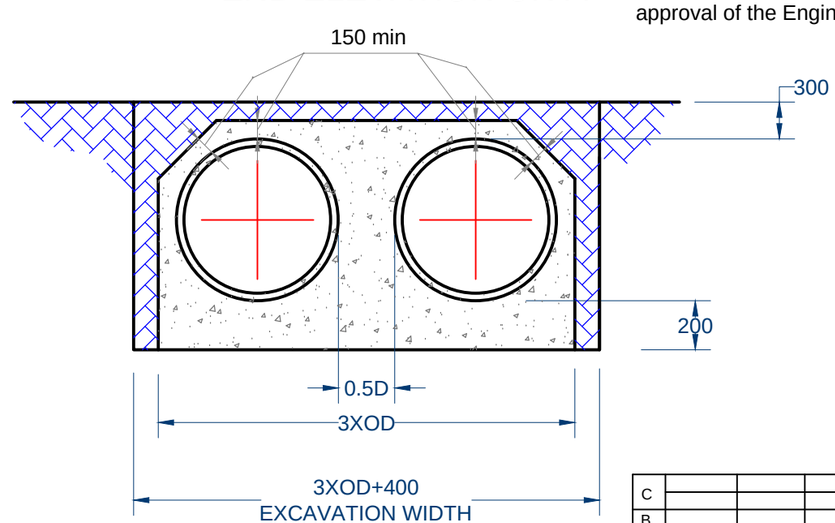
DRAWN	SCALE: 1:75 (at A3)	DRAWING NUMBER
DESIGNED		D - 03
CHECKED		
APPROVED B. JEBESSA	DATE: December 2011	
EDITED S. KIRSTEN		



PLAN VIEW



END ELEVATION ON A



CROSS SECTION ON B-B

KEY

- Concrete
- Masonry
- Dry stone pitching
- Grouted Stone Pitching
- Firm foundation Exsiting ground

Table of dimension (mm)

PIPE DIAMETER	A	B	C	D
600	400	1350	400	3500
900	450	1800	500	4800
1200	500	2250	600	6100
1350	550	2475	700	6700
1520	600	2730	800	7400

NOTES:

(1) All dimensions in mm.
(2) O.D. Out side diameter, I.D. Internal Diameter.
(3) Pipes may consist of the following: (a). plain concrete pipes with concrete surround 600 mm (b). reinforced concrete pipes with concrete bed and haunch (c). cast in situ internally formed pipes concrete class C 30/20 of minimum 200 mm thickness
(d). corrugated metal pipes
(4) Arrangement shown for stream culvert. Relief culvert similar but without side drain downstream to culvert on high side of road.

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

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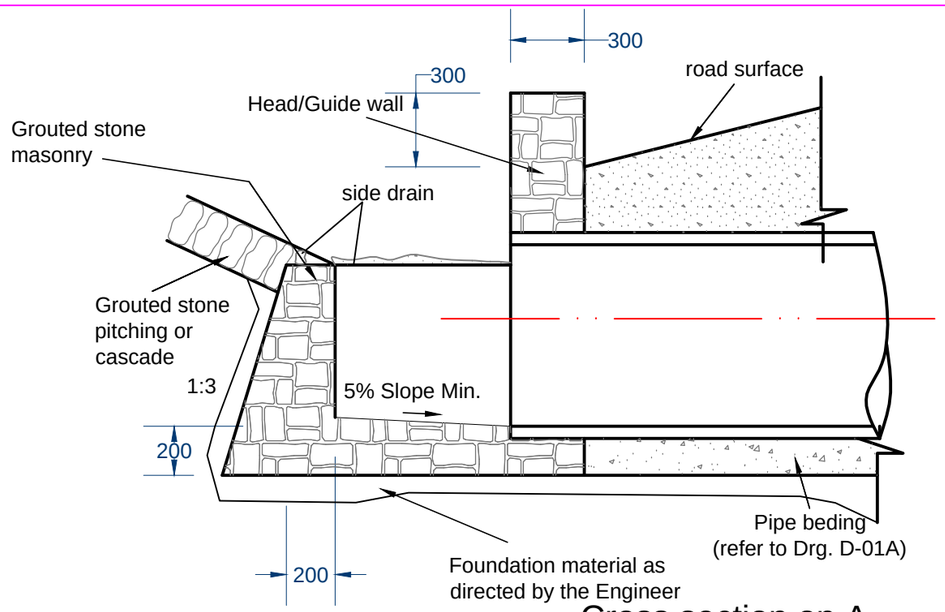
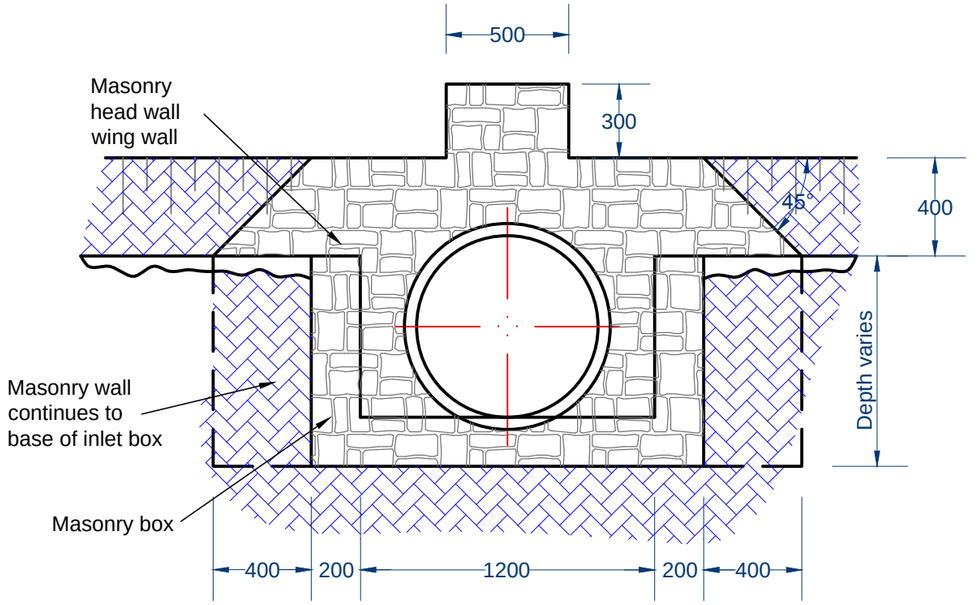
Culvert Alternative Arrangements
Twin barrel culvert - for high flow

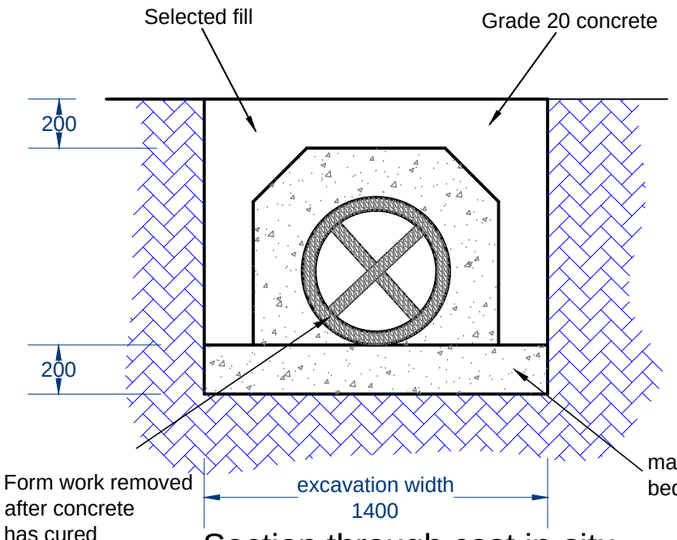
DRAWN		SCALE: 1:50 (at A3)	DRAWING NUMBER
DESIGNED			D-04
CHECKED		DATE: December 2011	
APPROVED	B. JEBESSA		
EDITED	S. KIRSTEN		



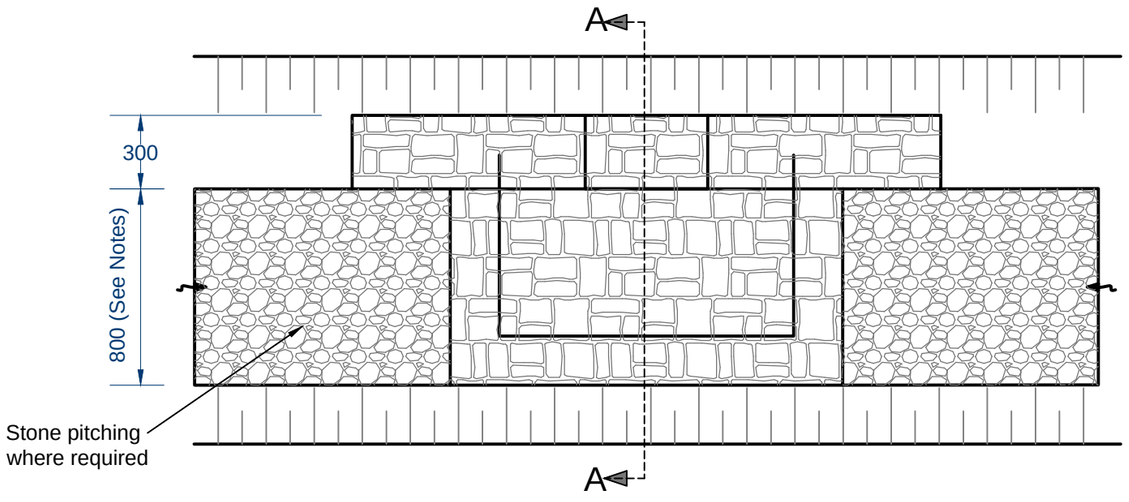
Cross section on A



Cross section on B B



Section through cast in-situ
600 mm diameter pipe



PLAN

600 mm diameter pipe drop inlet

KEY

- Concrete
- Masonry
- Firm foundation
  Exsiting ground

NOTES:

(1) All dimensions in mm.
(2) On cast in situ pipes, the minimum thickness of concrete surround to be 200 mm, and minimum cover above concrete to be 200 mm.
(3) * width of drop inlet may be increased from 800 mm according to width of side drains.
(4) Depth of drop inlet determined by site conditions.

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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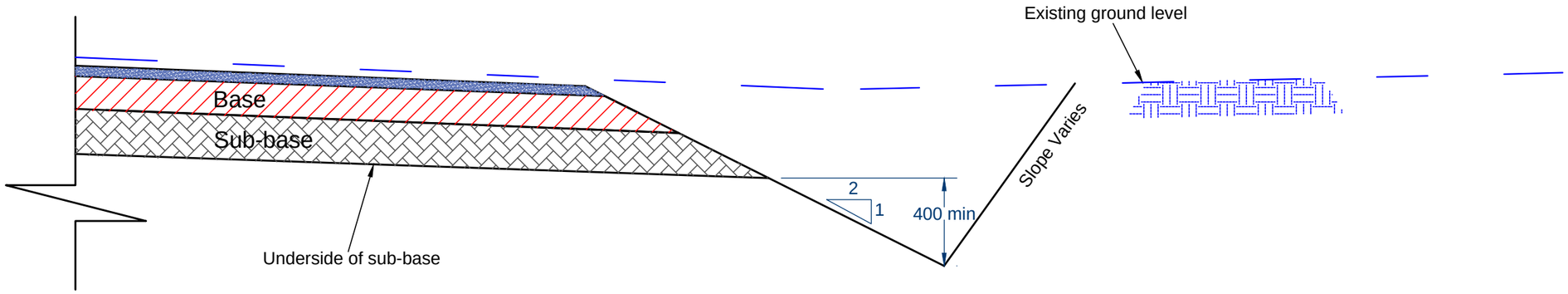
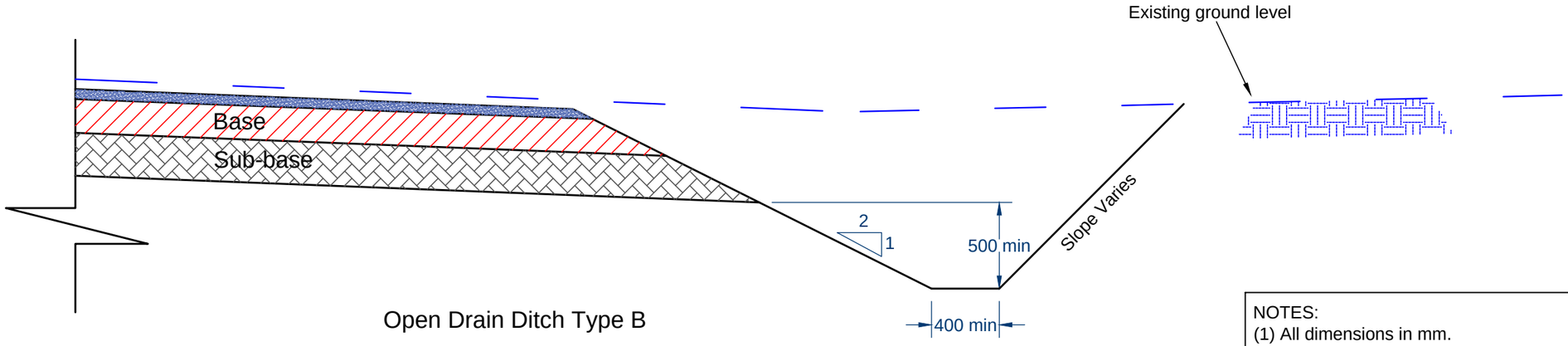
Culvert Alternative Arrangements

Drop inlet-for steeply sloping and flat ground, and cast in situ pipes

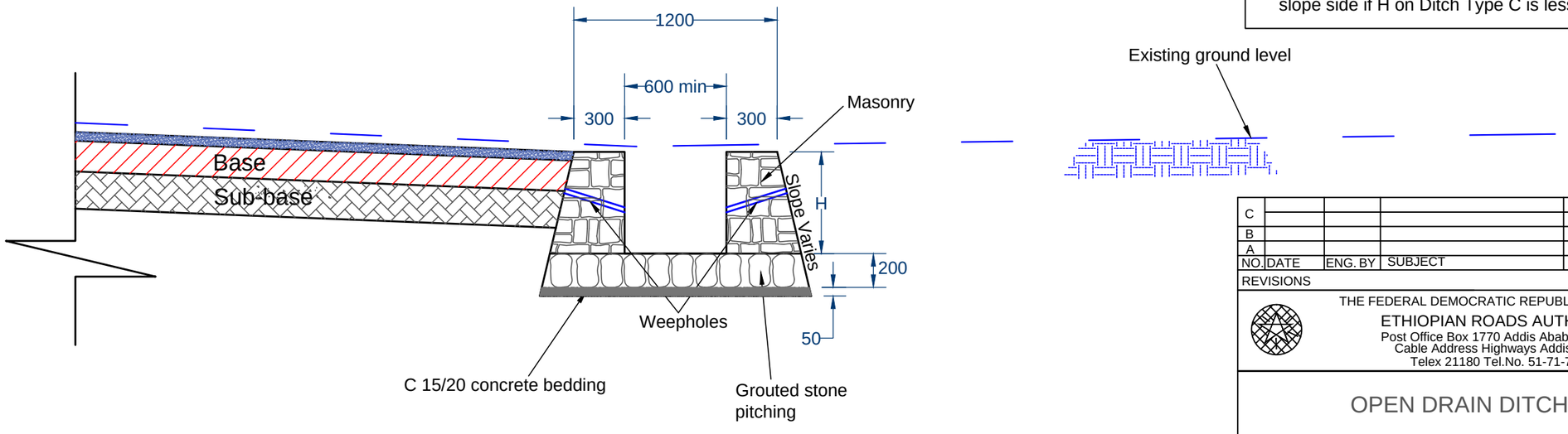
DRAWN	SCALE: 1:25 (at A3)	DRAWING NUMBER
DESIGNED		D-05
CHECKED		
APPROVED B. JEBESSA	DATE: December 2011	
EDITED S. KIRSTEN		



Open Drain Ditch Type A



Open Drain Ditch Type B



Open Drain Ditch Type C

NOTES:
(1) All dimensions in mm.
(2) If H exceeds 600, then wall is battered.
(3) Weep hole may be omitted from cutting slope side if H on Ditch Type C is less than 1m

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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B					
A					

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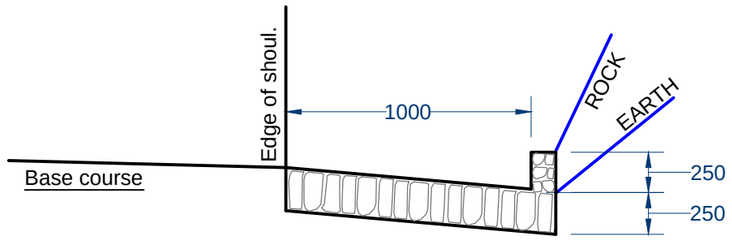
OPEN DRAIN DITCH TYPES

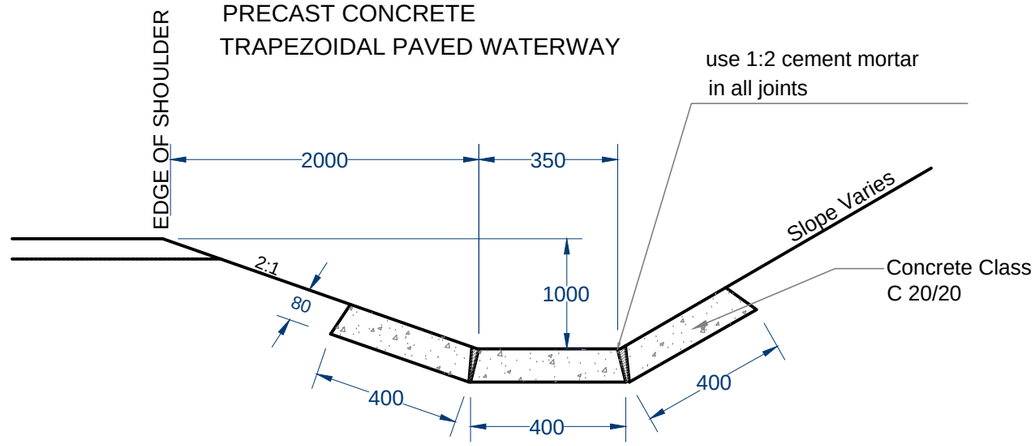
DRAWN	SCALE:1:30 (at A3)	DRAWING NUMBER
DESIGNED		D-06
CHECKED		
APPROVED B. JEBESSA	DATE: December 2011	
EDITED S. KIRSTEN		

GUTTERS
GROUTED STONE PITCHING WATERWAY



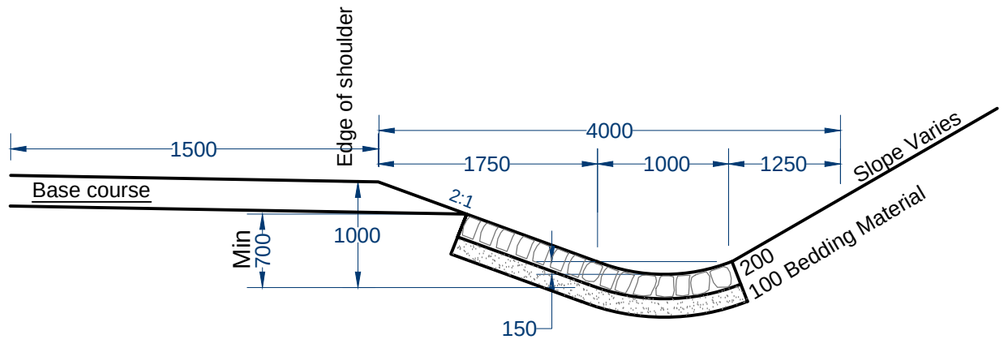
To back on to Retaining
Wall or for Town section

PRECAST CONCRETE
TRAPEZOIDAL PAVED WATERWAY



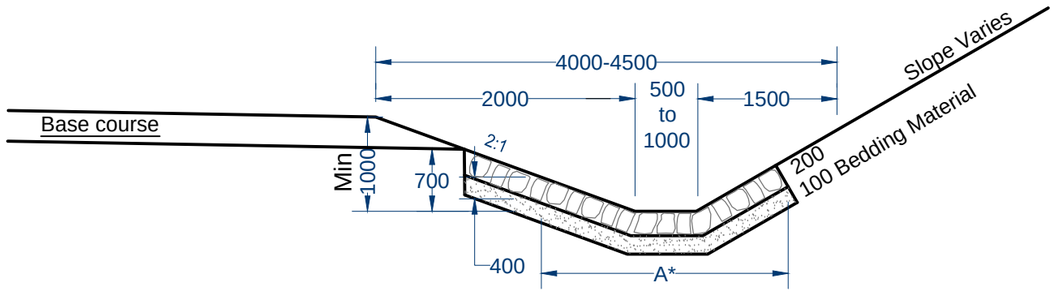
SECTION C-C

OPEN DRAIN TYPE D



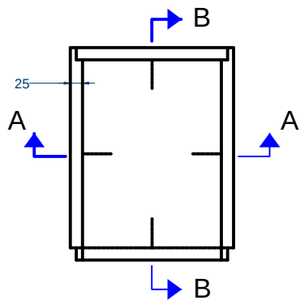
Type "B" paved waterway must be used where grade exceeds 5% and/or
where water velocities exceeds the erosion velocity of material encountered

OPEN DRAIN TYPE E

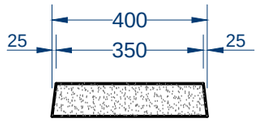


Type "C" Trapezoidal Paved channel for increased flow
* the width of pavement used in computing the pay area

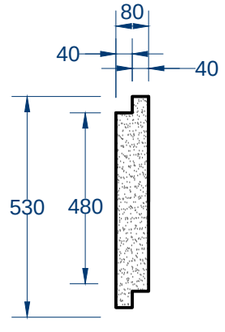
OPEN DRAIN TYPE F



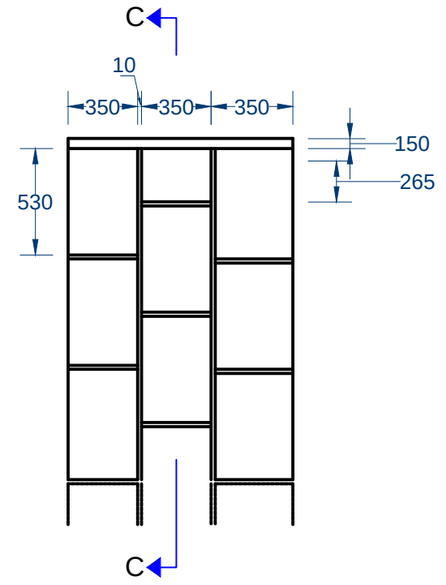
PANEL PLAN



SECTION A-A



SECTION B-B



PLAN

OPEN DRAIN TYPE G

Note :- All dimensions are in mm unless noted.

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
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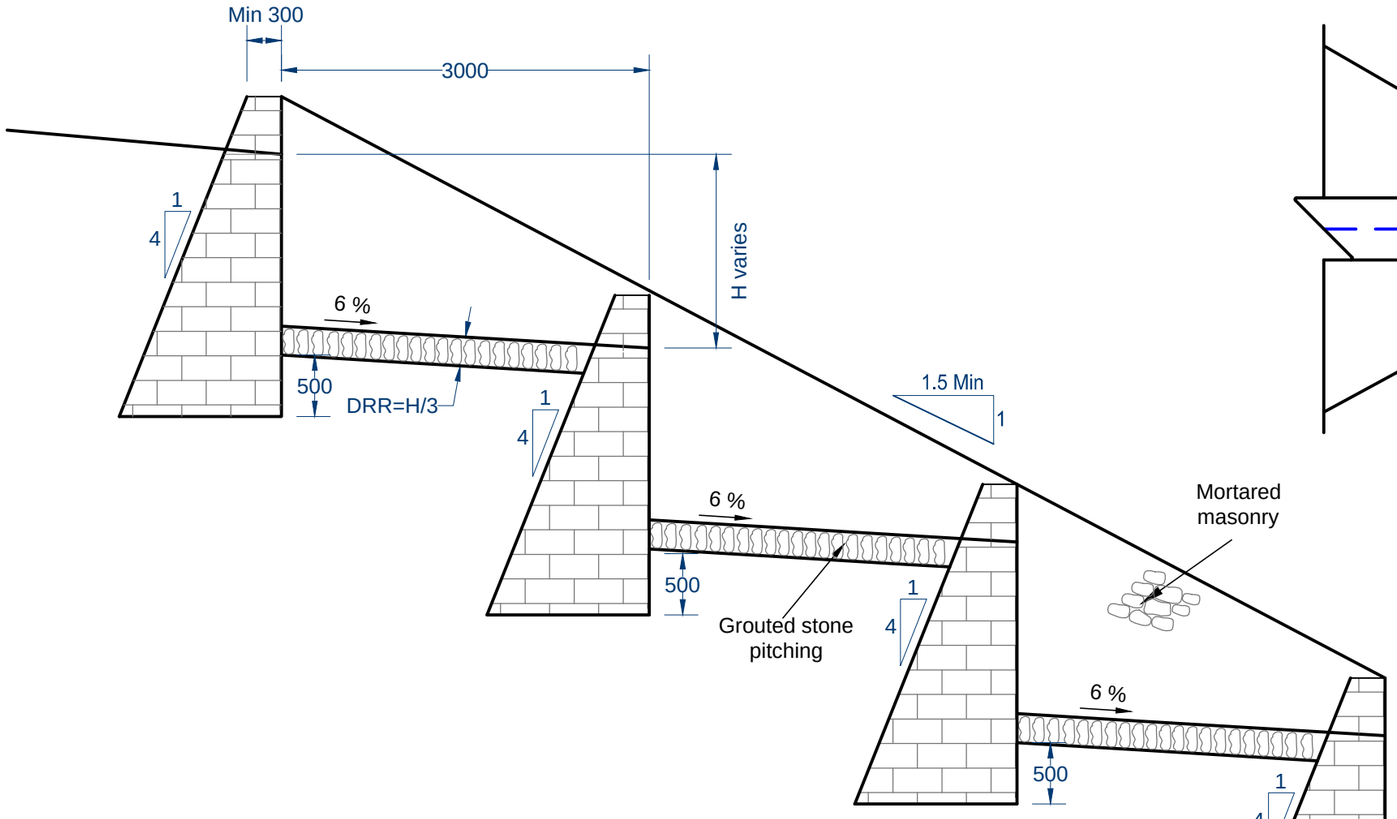
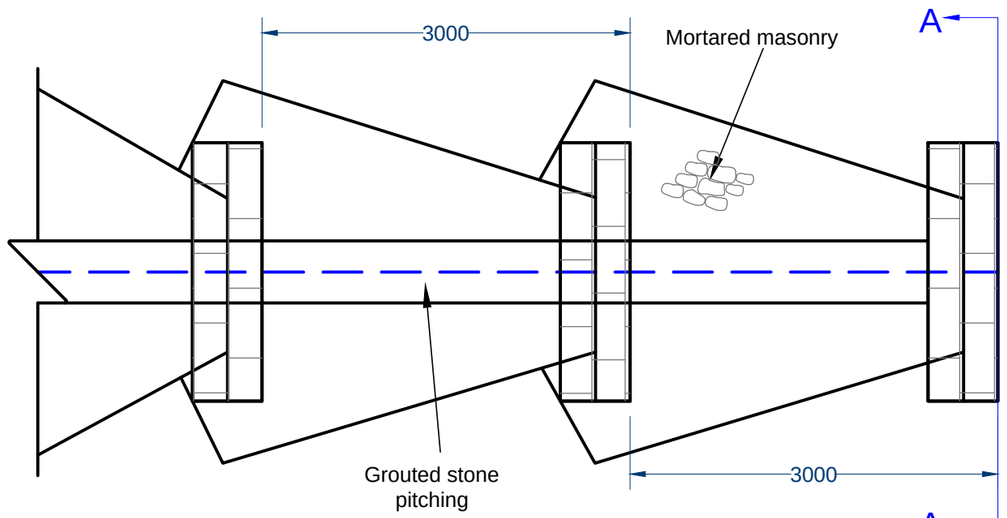
OPEN DRAINS

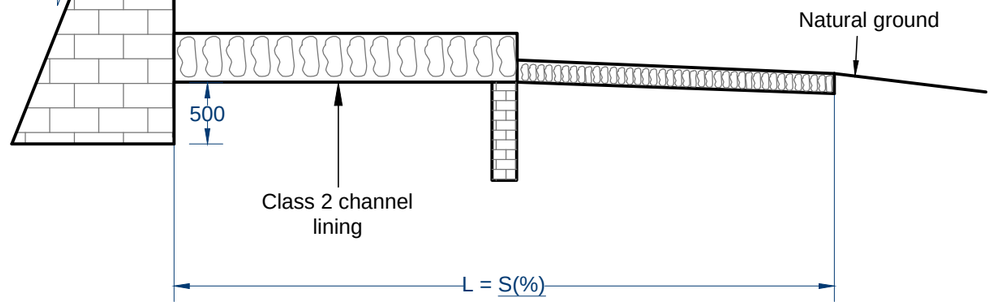
DRAWN		SCALE: NTS	DRAWING NUMBER
DESIGNED			D-07
CHECKED		DATE: December 2011	
APPROVED	B. JEBESSA		
EDITED	S. KIRSTEN		



SIDE VIEW CASCADE



PLAN CASCADE

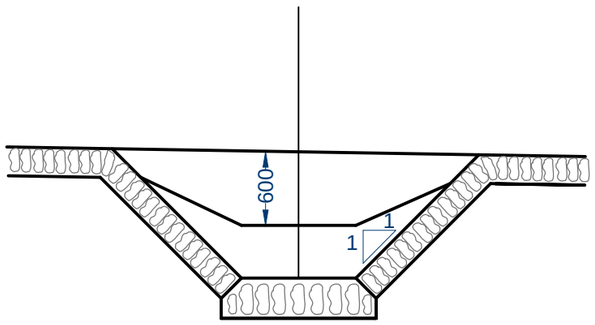


			CLASS STONE	D50
FOR	DRR	≤ 250	2	175
	250	- 400	3	300
	400	- 600	4	400
		> 600	5	500

KEY

- Mortared masonry
- Mortared masonry
- Grouted stone pitching

Note:
1. All dimensions in mm.
2. Dimensions to be instructed by the Engineer.



SECTION A-A

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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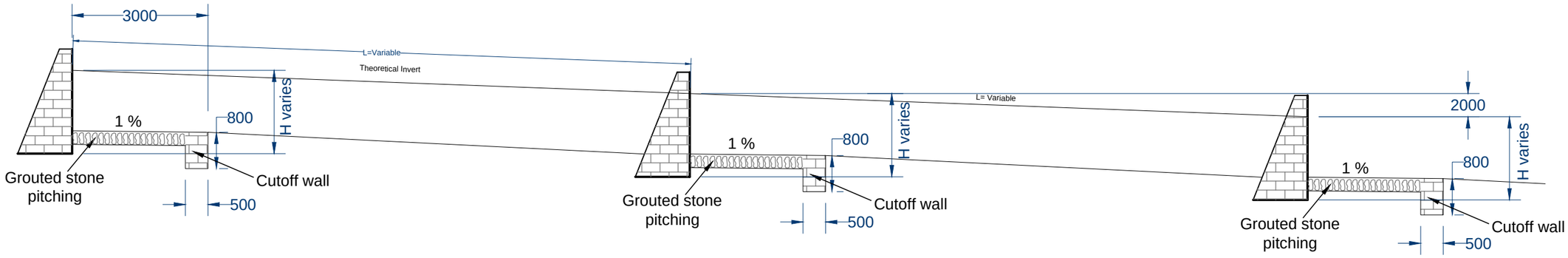
TYPICAL DETAILS OF CASCADE

DRAWN		SCALE:1:50 (at A3)	DRAWING NUMBER
DESIGNED			D-08
CHECKED		DATE: December 2011	
APPROVED	B. JEBESSA		
EDITED	S. KIRSTEN		



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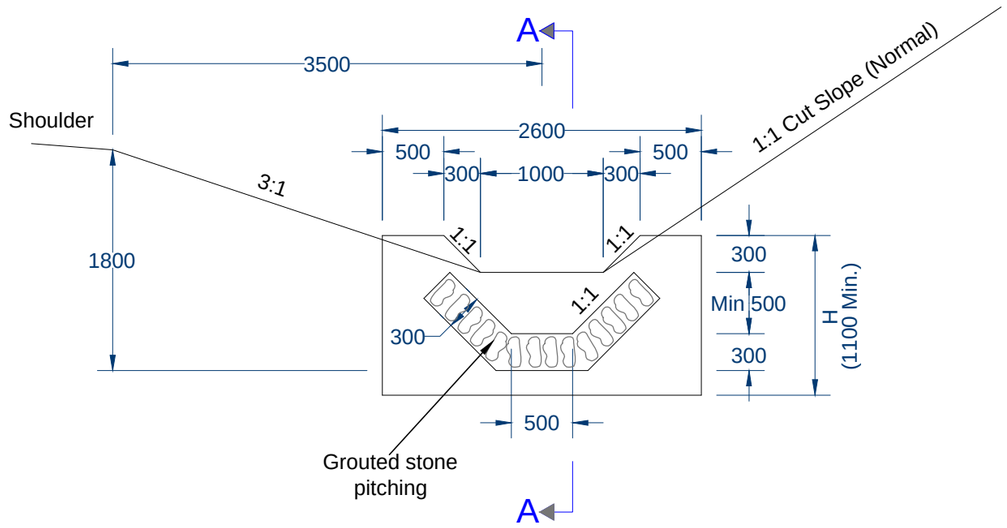

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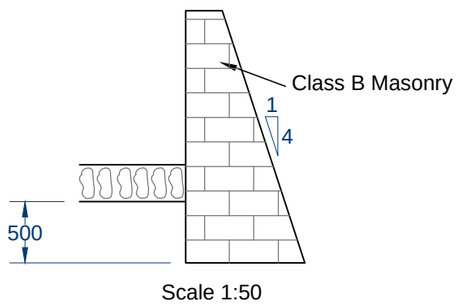

Scale 1:50

KEY

Mortared masonry

Grouted stone pitching

Note:
1. All dimensions in mm.

Note:
1. Check dams shall be constructed where the invert ditch grade is between 4% and 7%. Spacing between check dams shall be such as to reduce the effective invert grade to 3%.

Grade	Spacing
4%	50
5%	33
6%	25
7%	20

2. The side ditches shall be lined in sections where ditch invert gradients exceeding 5%, or in erosion defined gully sections as deemed necessary and as directed by the Engineer.

3. In town section, roadside drainage may include the addition of lined ditches, pedestrian crossing ditch cover slabs and piped ditch crossings for side road or vehicle access connections only where considered necessary and directed by the Engineer.

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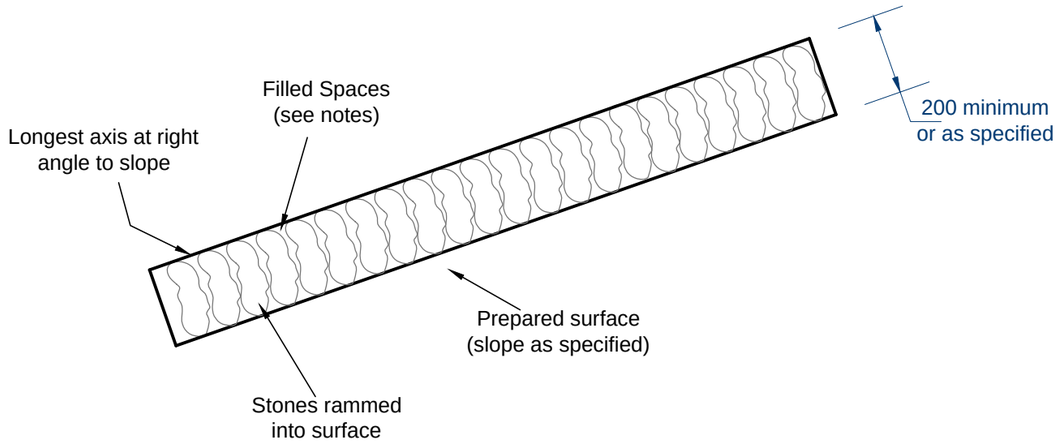
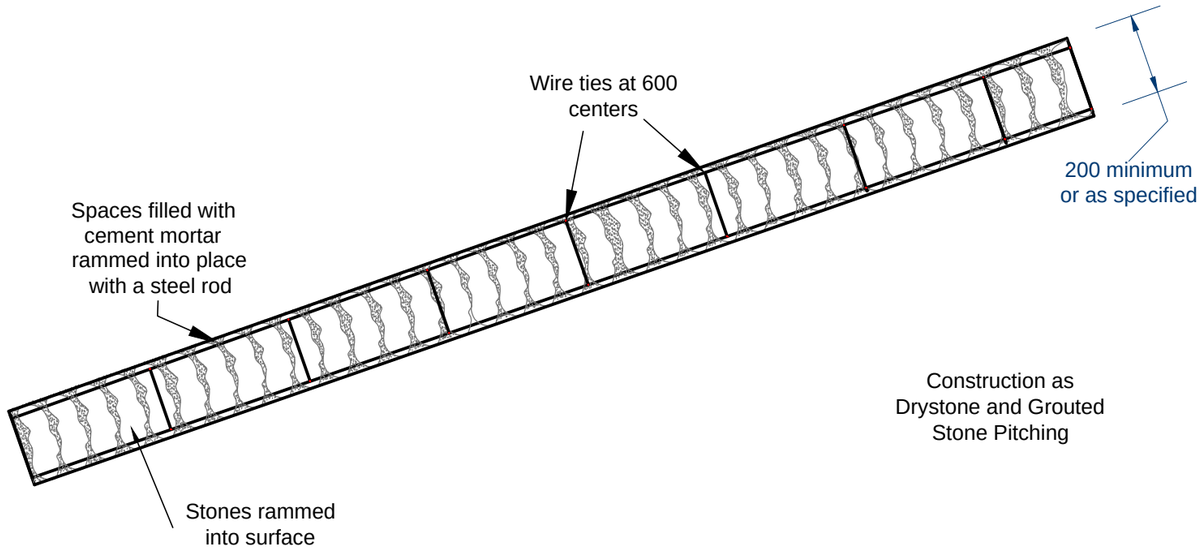
TYPICAL DETAILS OF CHECK DAMS

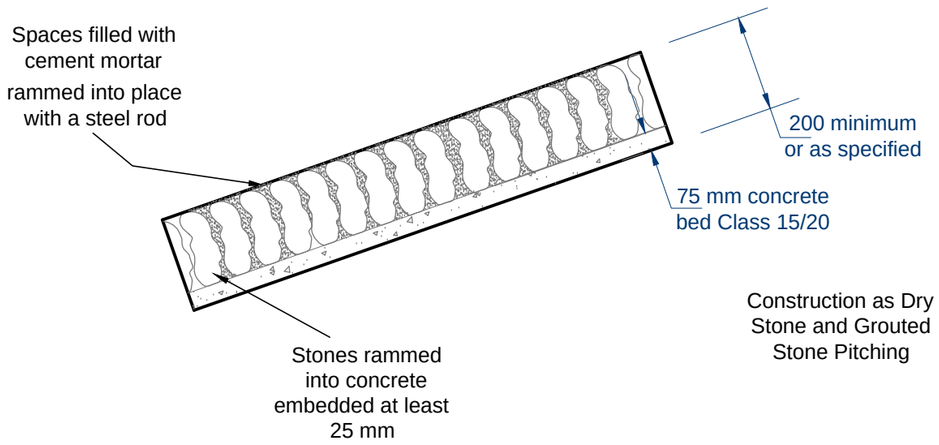
DRAWN		SCALE:As shown (at A3)	DRAWING NUMBER
DESIGNED			D-09
CHECKED			
APPROVED	B. JEBESSA	DATE: December 2011	
EDITED	S. KIRSTEN		


Longest axis at right angle to slope
Filled Spaces (see notes)
200 minimum or as specified
Prepared surface (slope as specified)
Stones rammed into surface

DRY STONE AND GROUTED STONE PITCHING


Wire ties at 600 centers
Spaces filled with cement mortar rammed into place with a steel rod
200 minimum or as specified
Construction as Drystone and Grouted Stone Pitching
Stones rammed into surface

WIRED AND GROUTED STONE PITCHING


Spaces filled with cement mortar rammed into place with a steel rod
200 minimum or as specified
75 mm concrete bed Class 15/20
Construction as Dry Stone and Grouted Stone Pitching
Stones rammed into concrete embedded at least 25 mm

GROUTED STONE PITCHING ON A CONCRETE BED

Notes:

1. All dimensions are in mm.
2. (a) Dry stone pitching method 1-spaces filled with stone fragments rammed into place.
   (b) Dry stone pitching method 2-spaces filled with topsoil with rooted grass
3. Grouted stone pitching-spaces filled with cement mortar rammed into place with a steel rod.

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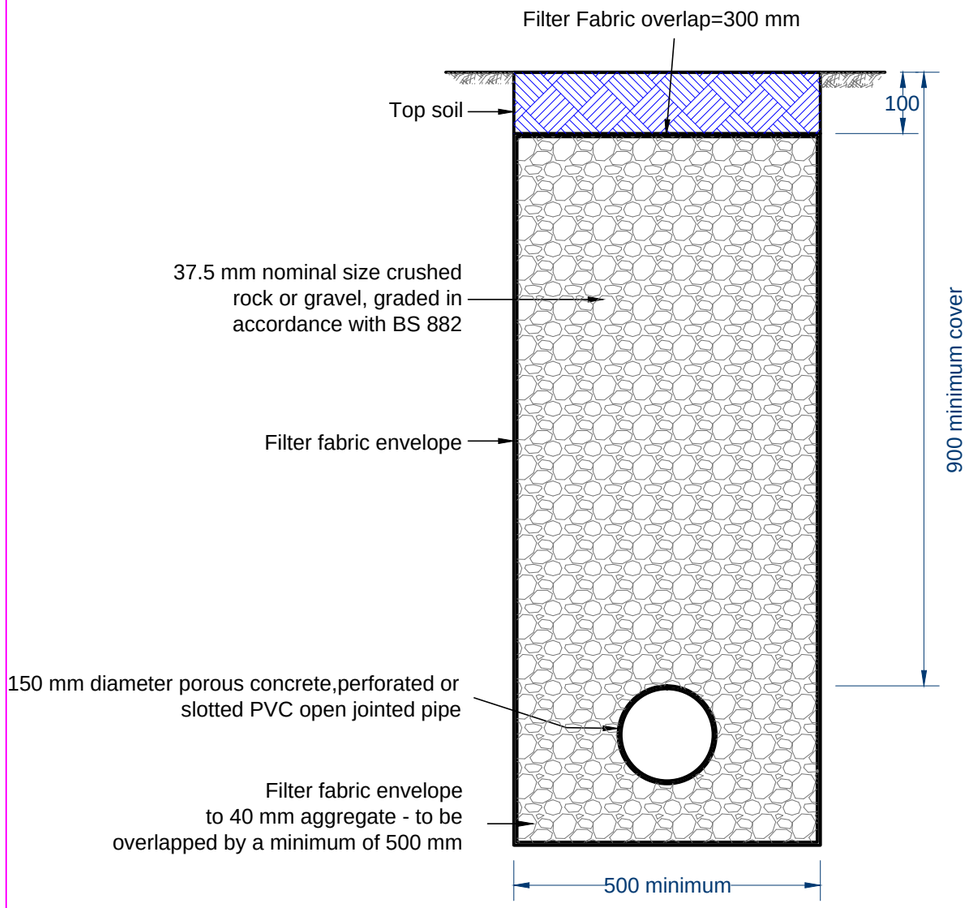
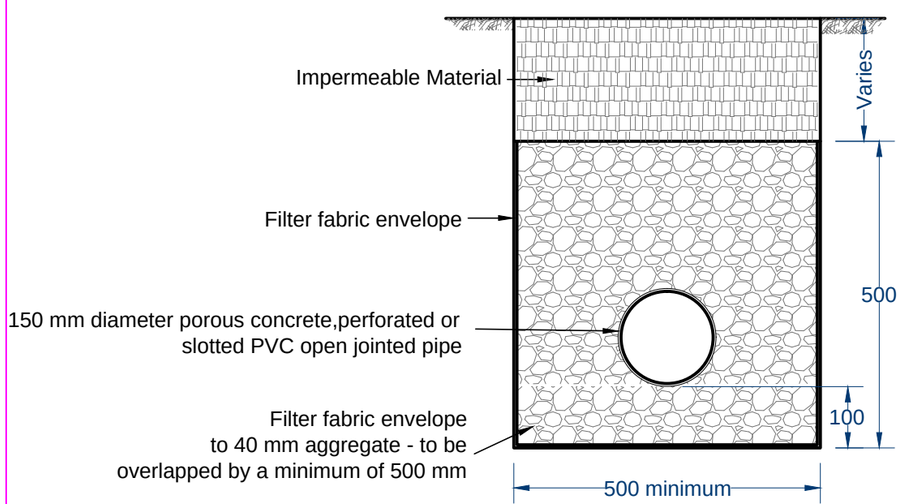
Pitching, Stonework and Erosion Control

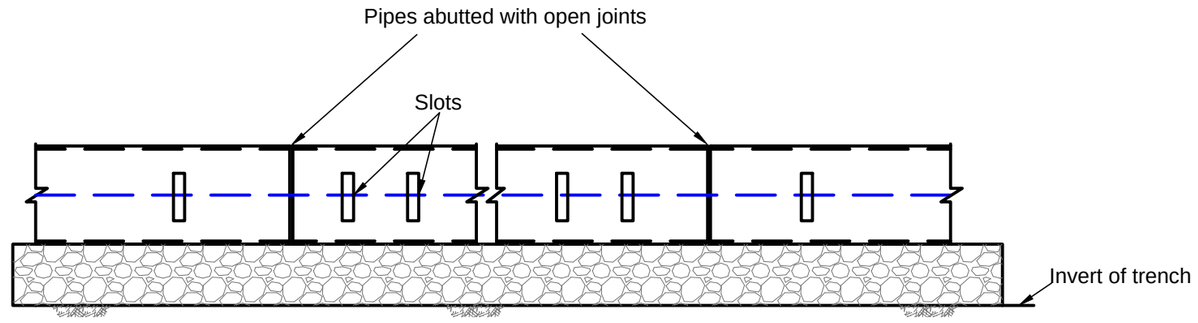
DRAWN	SCALE: 1:50 (at A3)	DRAWING NUMBER
DESIGNED		
CHECKED		
APPROVED B. JEBESSA	DATE: December 2011	D - 10
EDITED S. KIRSTEN		


Filter Fabric overlap=300 mm
Top soil
100
37.5 mm nominal size crushed rock or gravel, graded in accordance with BS 882
Filter fabric envelope
900 minimum cover
150 mm diameter porous concrete,perforated or slotted PVC open jointed pipe
Filter fabric envelope to 40 mm aggregate - to be overlapped by a minimum of 500 mm
500 minimum

FRENCH DRAIN TYPE A


Impermeable Material
Varies
Filter fabric envelope
500
150 mm diameter porous concrete,perforated or slotted PVC open jointed pipe
100
Filter fabric envelope to 40 mm aggregate - to be overlapped by a minimum of 500 mm
500 minimum

FRENCH DRAIN TYPE B



SIDE ELEVATION OF SLOTTED PIPE

Note:
1. Pipe maybe of PVC or porous concrete material. PVC pipes will be placed with the slots on the sides.
2. Depth to invert width of trench and pipe size may be varied by the Engineer to suit site condition/requirement.
3. Perforated pipe holes to the bottom.

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TYPICAL FRENCH DRAIN DETAIL

DRAWN	SCALE:1:10 (at A3)	DRAWING NUMBER
DESIGNED		D-12
CHECKED		
APPROVED B. JEBESSA	DATE: December 2011	
EDITED S. KIRSTEN		

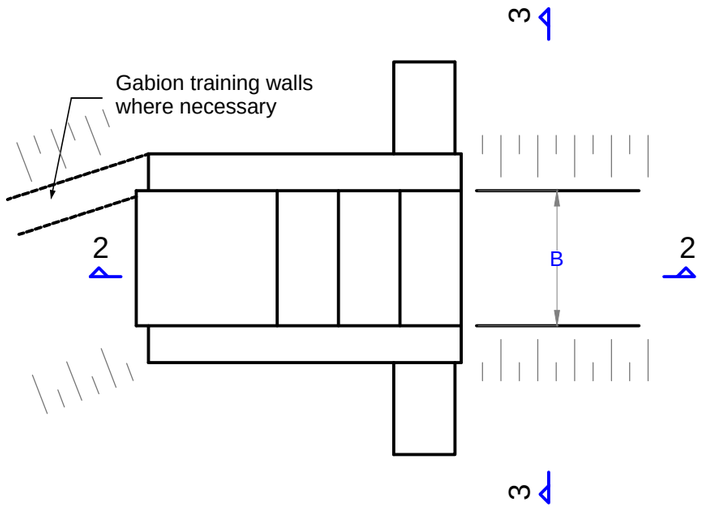


TABLE 1
(Dimensions are in Metres)

Culvert size	'B'	Drop 'H'									
		3		4		5		6		7	
		D_{sh}	L_{sh}	D_{sh}	L_{sh}	D_{sh}	L_{sh}	D_{sh}	L_{sh}	D_{sh}	L_{sh}
0.6 dia	2.0	1.0	2.3	1.0	2.4	1.0	2.5	1.0	2.6	1.0	2.7
0.9 dia	3.0	1.0	2.9	1.0	3.1	1.0	3.3	1.5	3.4	1.5	3.6
1.2 dia	4.0	1.5	3.6	1.5	4.0	1.5	4.2	2.0	4.4	2.0	4.6

NOTE 1:-

1- Gabion cascade type A is for use where ground slope is too steep to accommodate a stilling basin. Gabion cascade type B is for use on shallower slopes where there is room for a stilling basin.It is always important to consider energy dissipation and bed protection downstream of cascades to accommodate the over design discharge which can be anticipated during the life of the structure.

2- Gabion cascade type A and B shall be used only for through road culverts no larger than the size quoted in Tables 1 and 2 respectively and shall be constructed to the dimensions shown in the tables. At discharges from larger culverts and over design discharge the cascade will not provide full energy dissipation, and as flow increases will function as a chute.

3- The maximum drop for a type A gabion cascade is 7m as shown in Table 1.

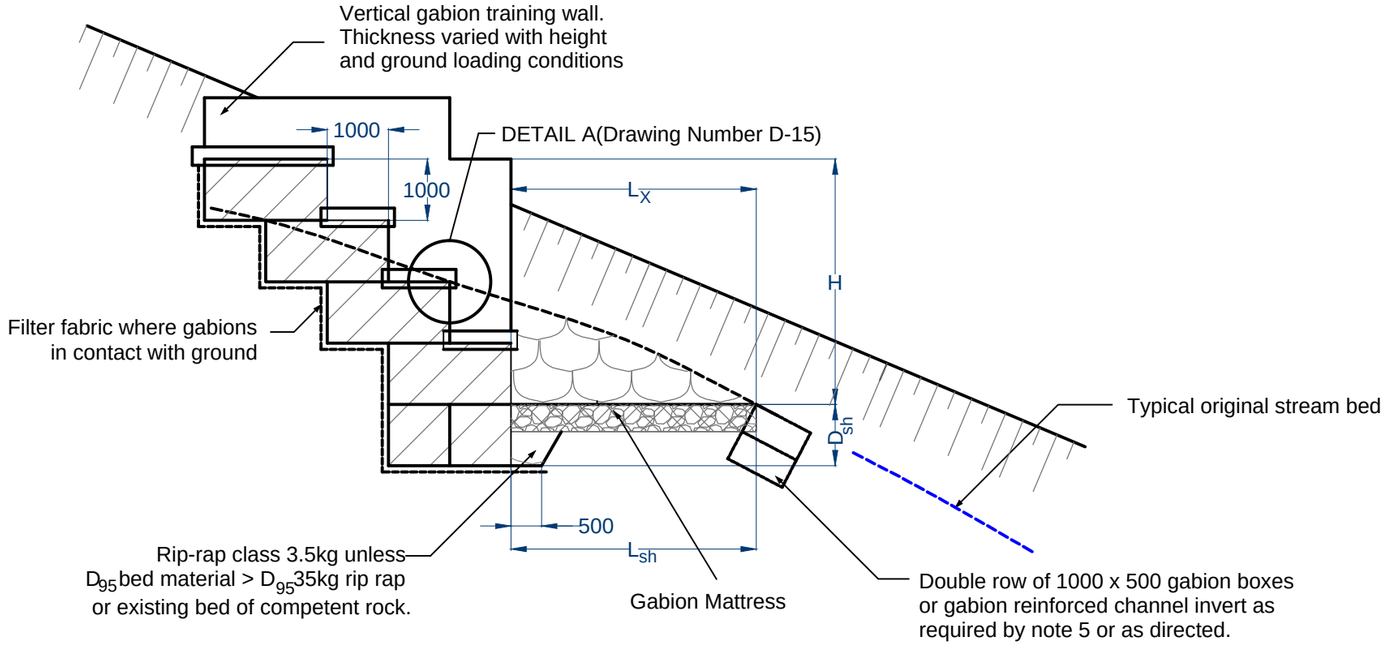
4- The drop / number of steps for a type B gabion cascade may be varied to suit the stream and ground slope.

5- If the dimension Lx is greater than the value of Lsh shown in Table , then protection work shall be provided to a distance Lx from the end of the cascade. If the value Lsh is greater than Lx then a double row of gabion boxes shall be placed at the point where the rip-rap protection meets the original stream bed (i.e. at a distance Lx from the end of the cascade).

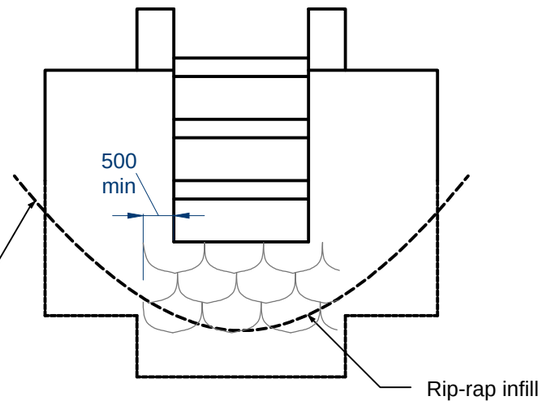
6- Concrete to cascade steps Concrete Class C 20/20

7- Gabion mesh size 80 x 100mm
Mattress mesh size 60 x 80mm

8- Foundation bearing surfaces shall be horizontal. Unsuitable material shall be replaced with suitable material.



SECTION 2-2



SECTION 3-3

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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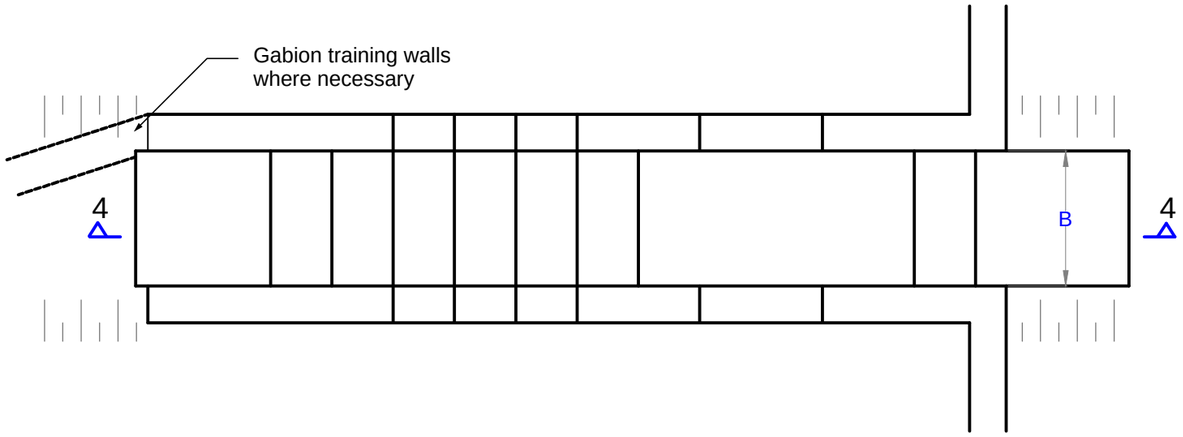
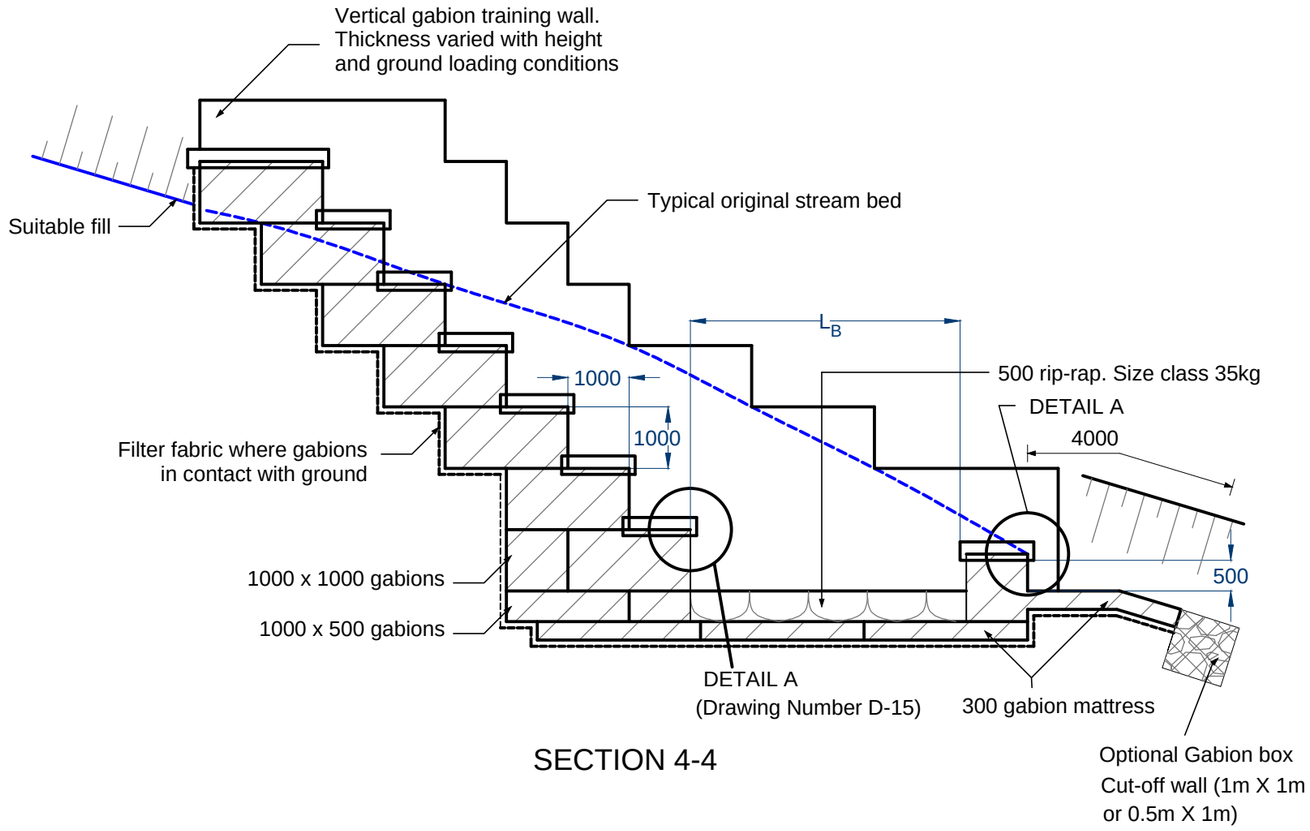
GABION CASCADE TYPE A

DRAWN		SCALE1:100(at A3)	DRAWING NUMBER
DESIGNED			D-13
CHECKED		DATE: December 2011	
APPROVED	B. JEBESSA		
EDITED	S. KIRSTEN		





SECTION 4-4

NOTE 1:-

1- Gabion cascade type A is for use where ground slope is too steep to accommodate a stilling basin. Gabion cascade type B is for use on shallower slopes where there is room for a stilling basin.It is always important to consider energy dissipation and bed protection downstream of cascades to accommodate the over design discharge which can be anticipated during the life of the structure.

2- Gabion cascade type A and B shall be used only for through road culverts no larger than the size quoted in Tables 1 and 2 respectively and shall be constructed to the dimensions shown in the tables. At discharges from larger culverts and over design discharge the cascade will not provide full energy dissipation, and as flow increases will function as a chute.

3- The maximum drop for a type A gabion cascade is 7m as shown in Table 1.

4- The drop / number of steps for a type B gabion cascade may be varied to suit the stream and ground slope.

5- If the dimension Lx is greater than the value of Lsh shown in Table , then protection work shall be provided to a distance Lx from the end of the cascade. If the value Lsh is greater than Lx then a double row of gabion boxes shall be placed at the point where the rip-rap protection meets the original stream bed (i.e. at a distance Lx from the end of the cascade).

6- Concrete to cascade steps Concrete Class C 20/20

7- Gabion mesh size 80 x 100mm
Mattress mesh size 60 x 80mm

8- Foundation bearing surfaces shall be horizontal. Unsuitable material shall be replaced with suitable material.

TABLE 2
(Dimensions are in Meters)

Culvert size	'B'	L_B
0.6 dia	2.0	4.5
0.9 dia	3.0	6.5
1.2 dia	4.0	8.5

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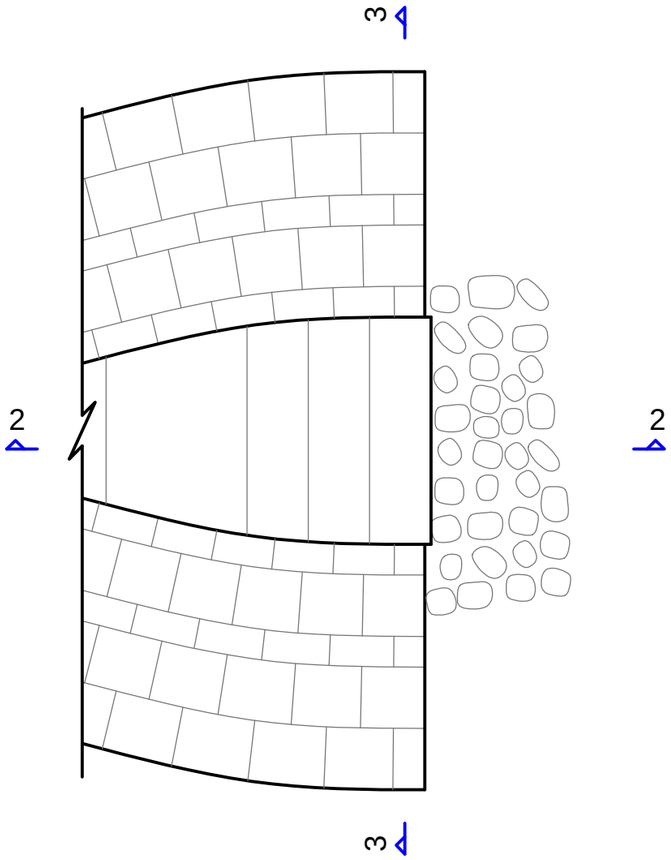
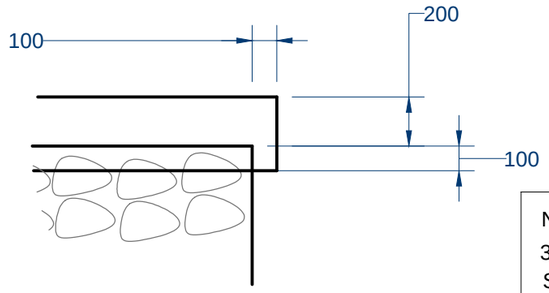
GABION CASCADE TYPE B

DRAWN	SCALE: 1:100(at A3)	DRAWING NUMBER
DESIGNED		D-14
CHECKED		
APPROVED B. JEBESSA	DATE: December 2011	
EDITED S. KIRSTEN		

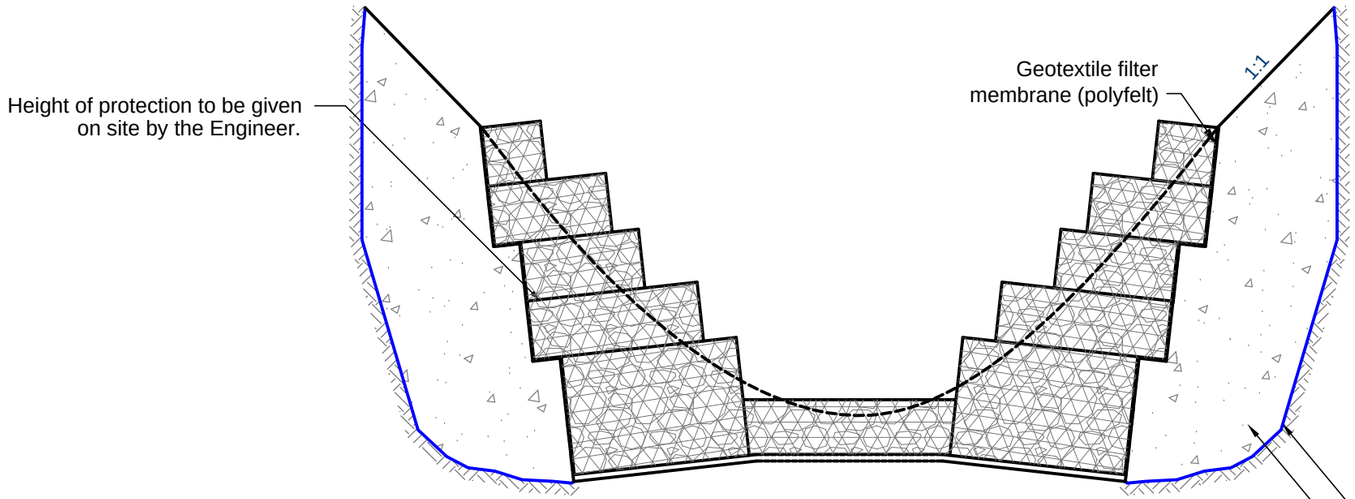




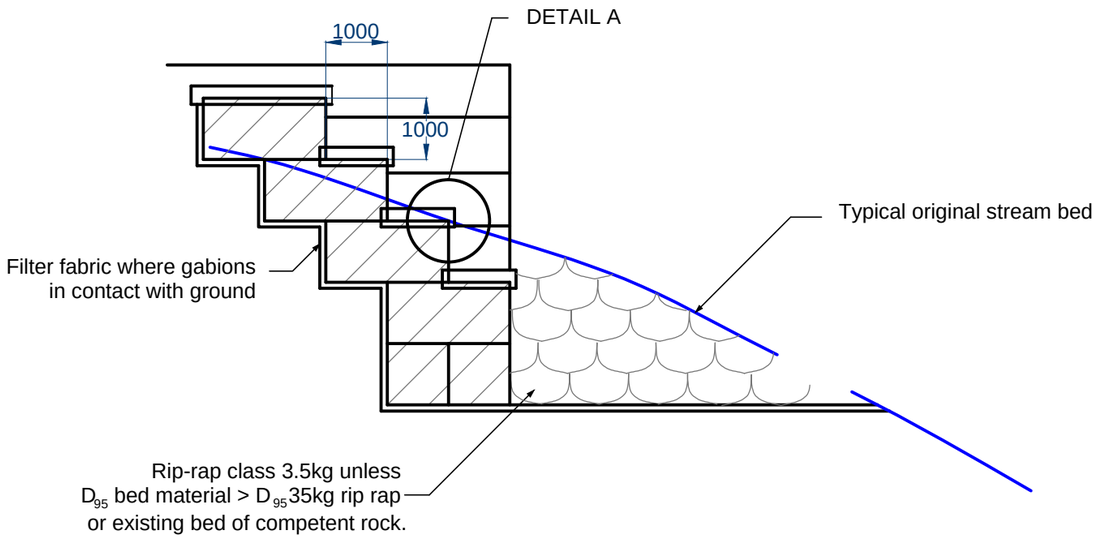
DETAIL A

Scale 1:25

Note:
300 Thick concrete crest slab.
Slab shall be cast after settlement of gabions.


Height of protection to be given on site by the Engineer.
Geotextile filter membrane (polyfelt)
1:1
Selected free draining backfill
Unstable material

SECTION 3-3


DETAIL A
1000
1000
Typical original stream bed
Filter fabric where gabions in contact with ground
Rip-rap class 3.5kg unless D_{95} bed material > D_{95} 35kg rip rap or existing bed of competent rock.

SECTION 2-2

NOTE 1:-
- Engineer to determine arrangement of gabion baskets as required,depending on erosion susceptibility of cut slope material and depth/width of existing stream bed
- For notes on gabion details and construction see Drawing No. D-13 and D-14.

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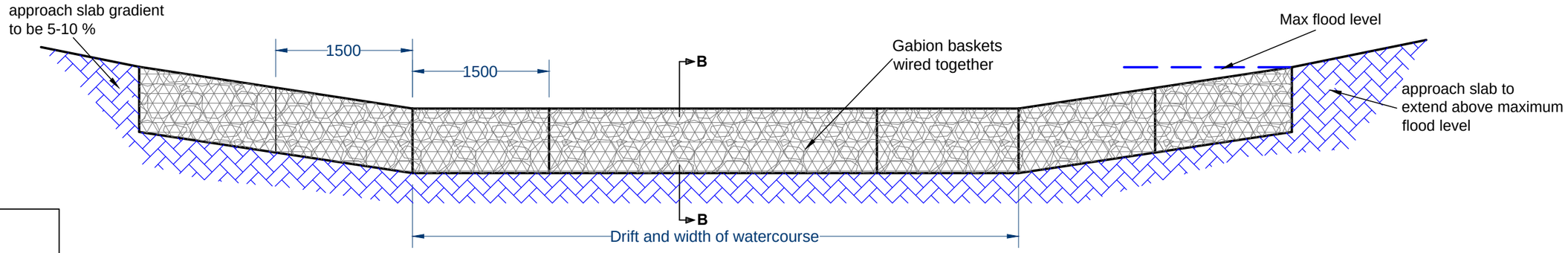
GULLY GABION CASCADE

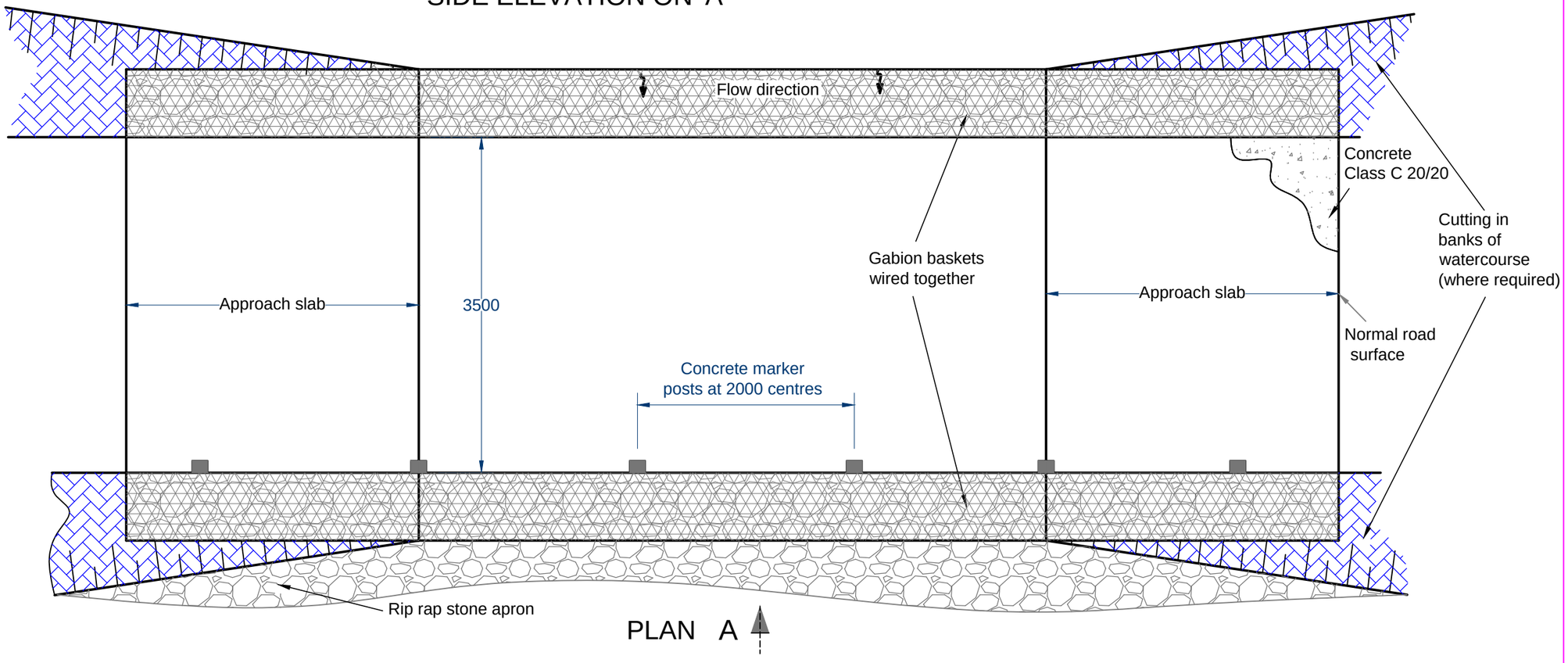
DRAWN		SCALE: 1:100 (at A3)	DRAWING NUMBER
DESIGNED			D-15
CHECKED		DATE: December 2011	
APPROVED	B. JEBESSA		
EDITED	S. KIRSTEN		



SIDE ELEVATION ON 'A'

KEY

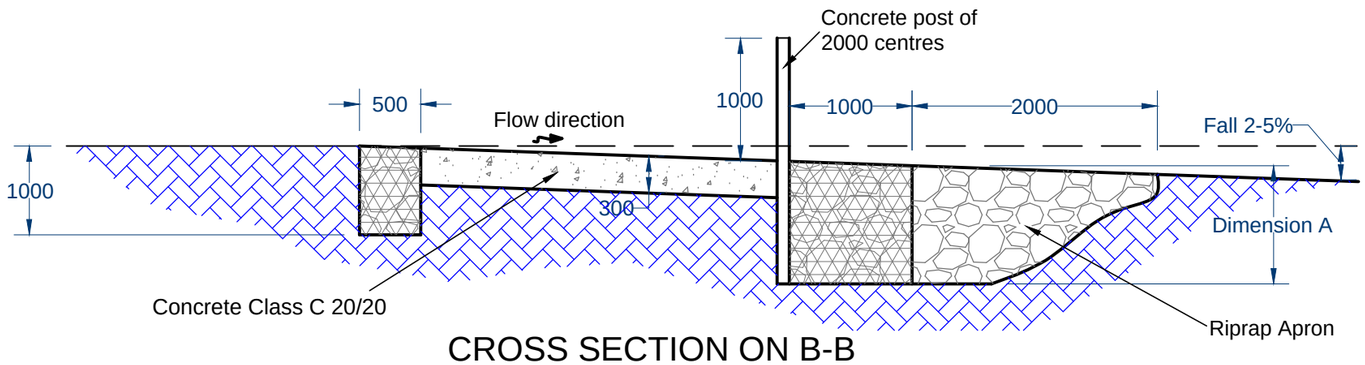
- Concrete
- Gabion baskets
- Rip-rap stone
- Firm foundation/ Existing ground



PLAN A

NOTES:

(1) All dimensions in mm.
(2) Drift warning sign to be placed on approaches 100m before drift.
(3) Top of Gabion Baskets to be placed at the level of stream bed maximum flood level (to be 5 or 10 years flood depending on road importance).
(4) Dimension 'A' - 1m - 1.5m depending on scour risk.
(5) Dimension 'B' - 0.7m - 1m depending on scour risk.
(6) Drift running width to be same as road width.
(7) Gabions may be substituted by masonry or concrete cut-off walls.



CROSS SECTION ON B-B

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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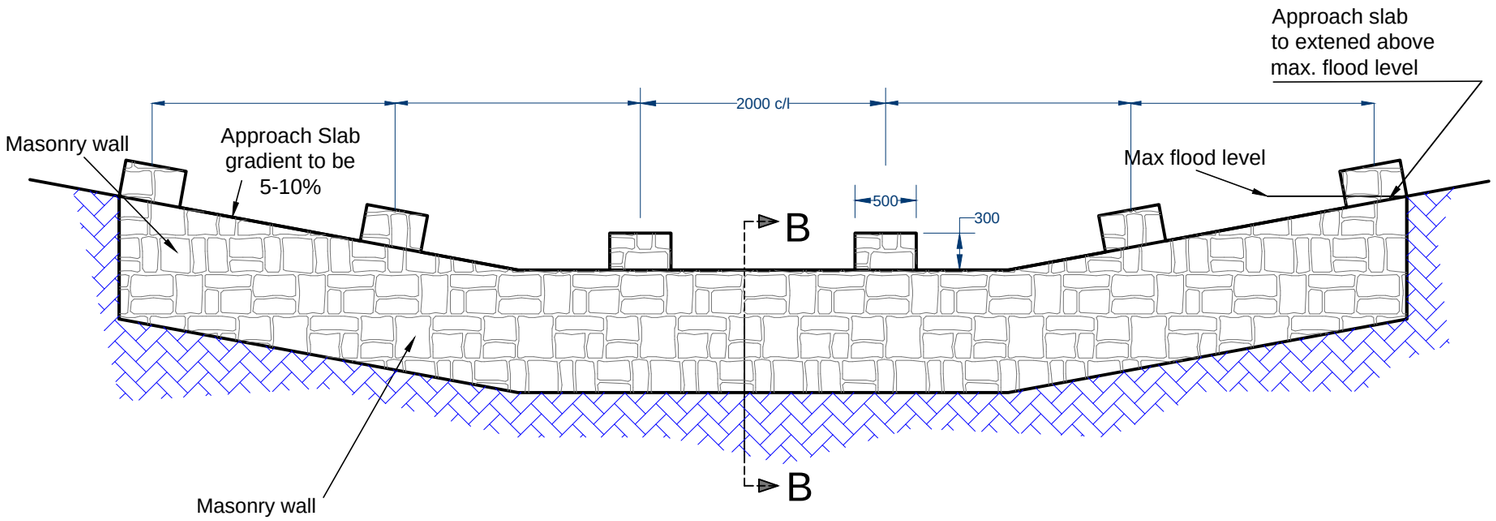
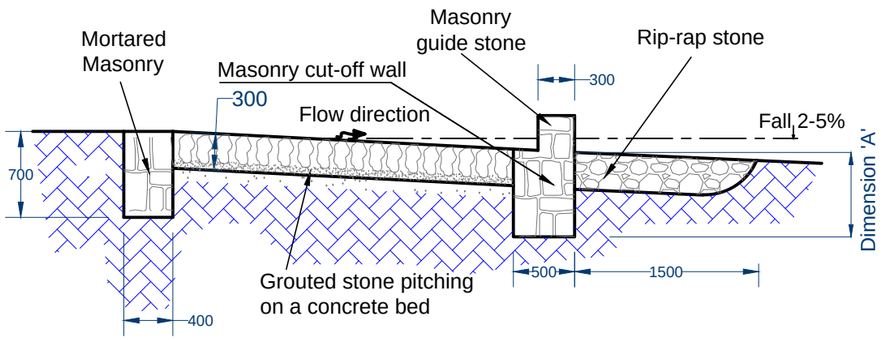
Gabion Drift

Concrete and Gabions for high velocity flows

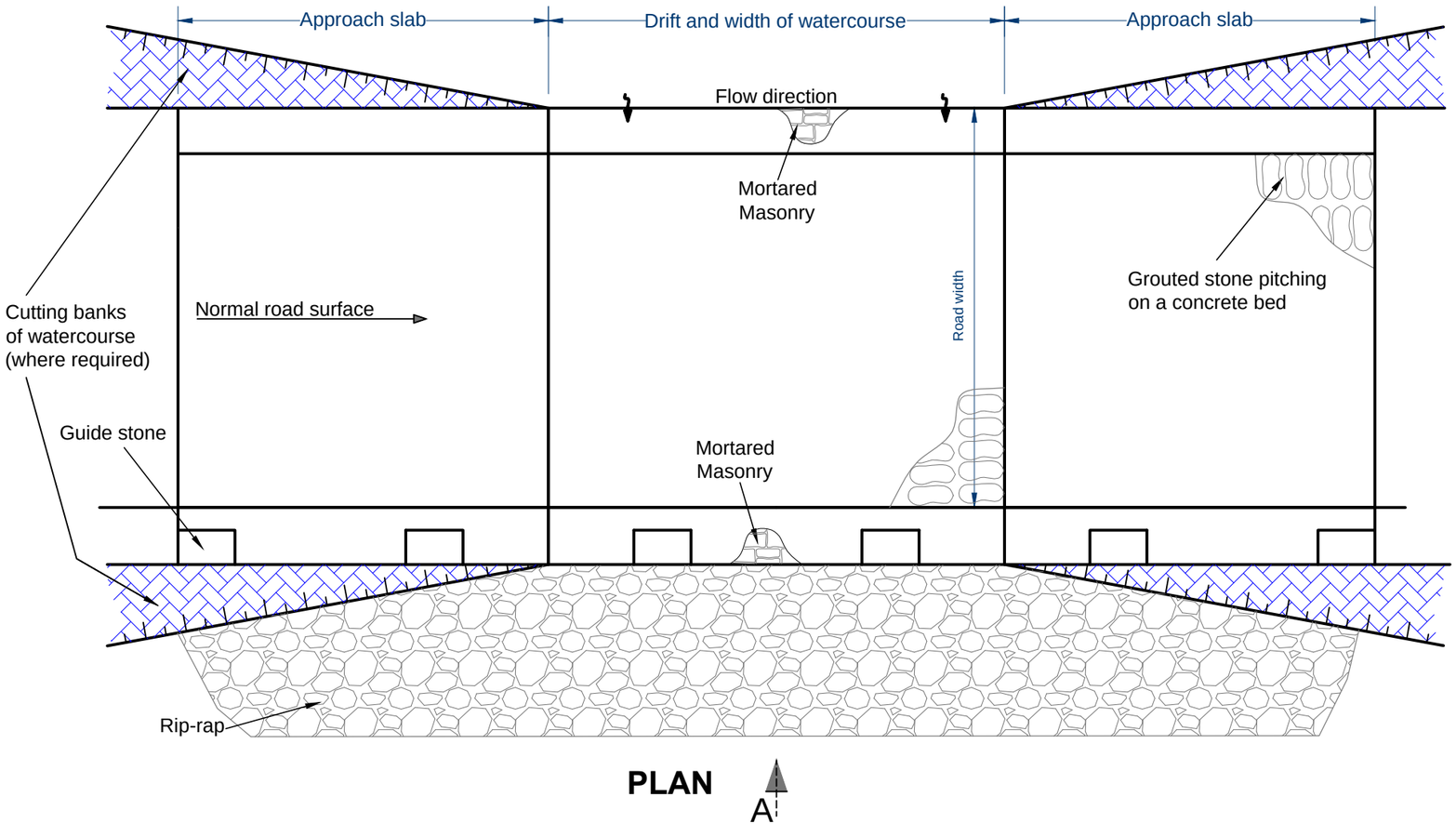
DRAWN		SCALE: 1:50 (at A3)	DRAWING NUMBER
DESIGNED			D-16
CHECKED		DATE: December 2011	
APPROVED	B. JEBESSA		
EDITED	S. KIRSTEN		



SIDE ELEVATION ON 'A'



CROSS SECTION ON B-B



PLAN

NOTES:

(1) All dimensions in mm.
(2) Dimension 'A' -1m-1.5m depending on scour risk.
(3) Guide stone to be painted white.
(4) Maximum flood level to be 5 or 10 years flood depending on road importance.
(5) Drift warning sign to be placed on approaches 100m before drift
(6) Top of drift to be at existing stream bed level.
(7) Drift running width to be same as road width.

KEY

- Rip-rap
- Mortared Masonry
- Grouted Stone Pitching on a Concrete Bed
- Firm foundation Existing ground

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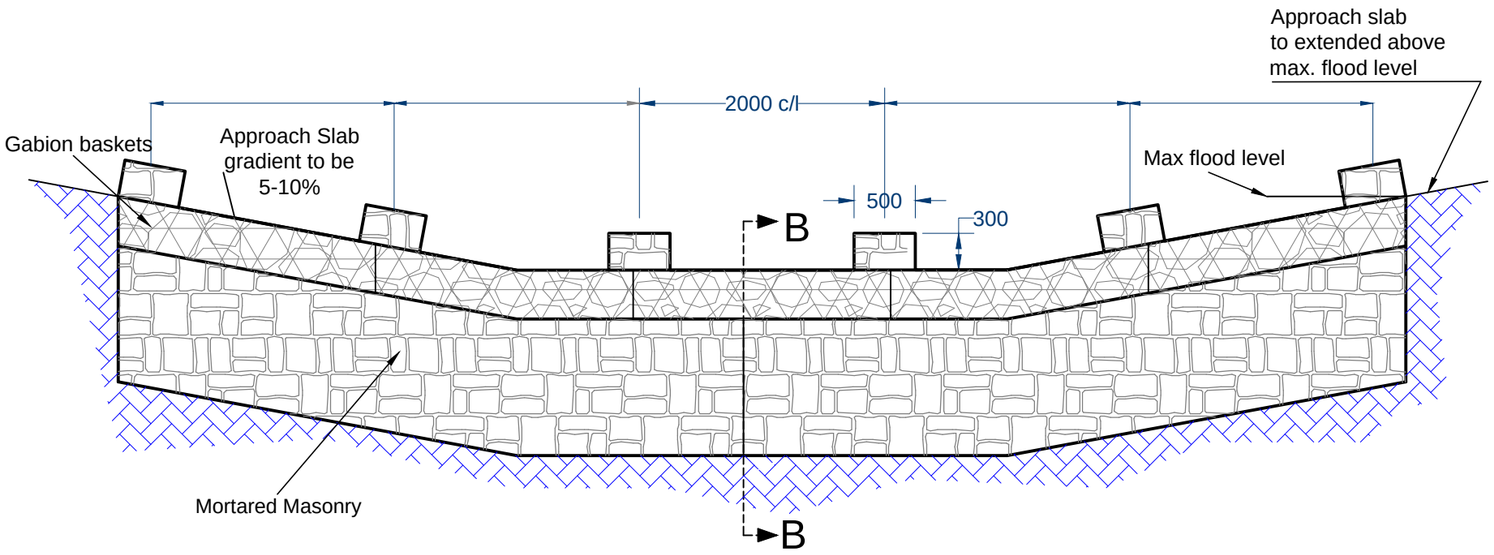
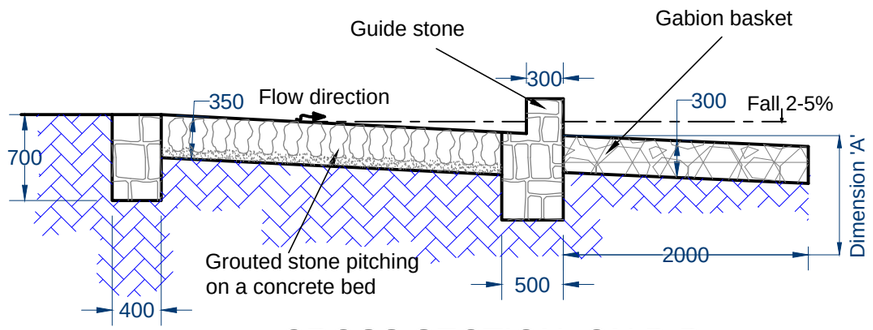
GROUTED STONE PITCHED DRIFT with RIPRAP

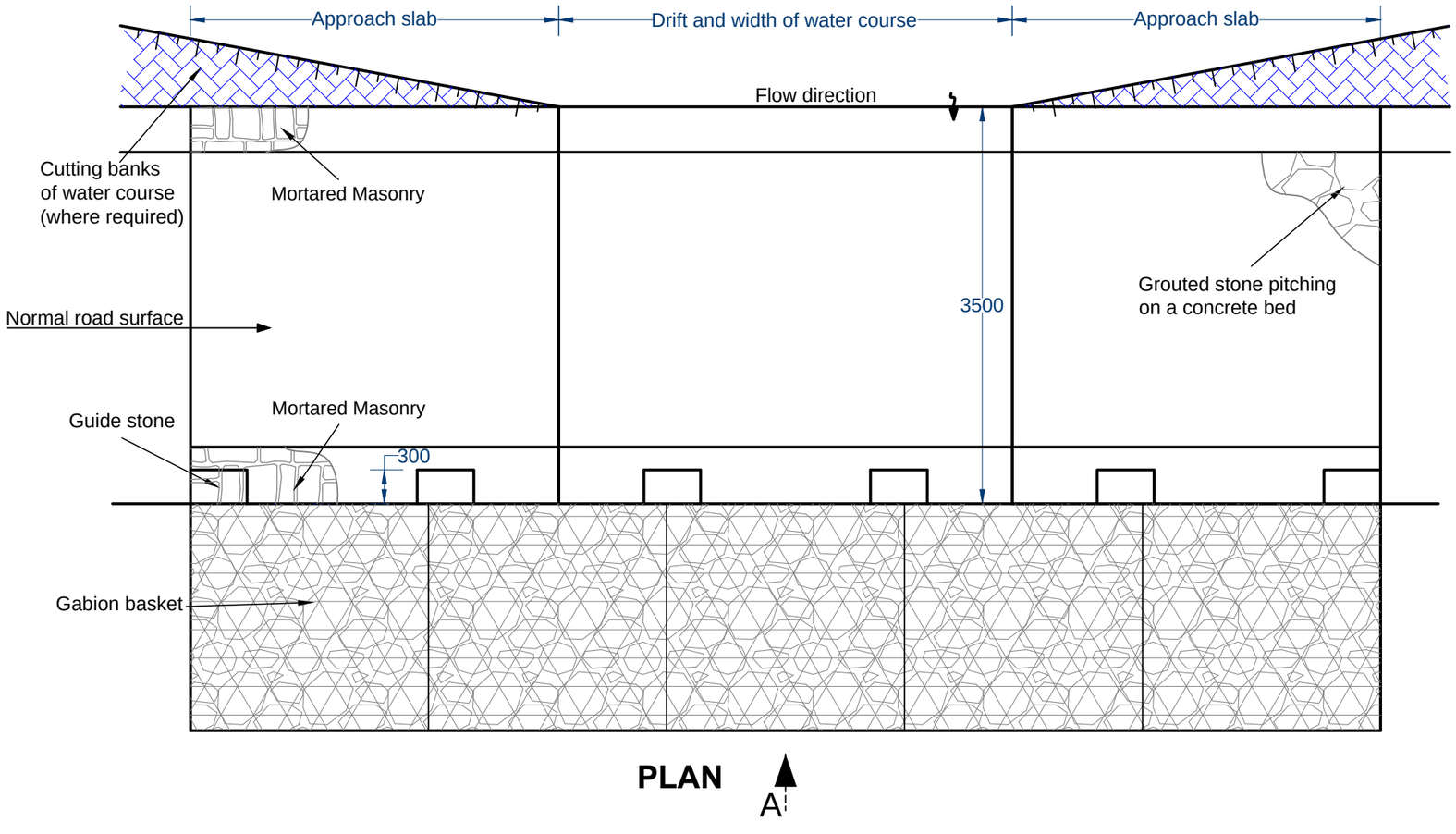
DRAWN	SCALE: 1:50 (at A3)	DRAWING NUMBER
DESIGNED		D-17
CHECKED		
APPROVED B. JEBESSA	DATE: December 2011	
EDITED S. KIRSTEN		



SIDE ELEVATION ON 'A'



CROSS SECTION ON B-B



PLAN

NOTES:

(1) All dimensions in mm.
(2) Drift warning sign to be placed on approaches 100m before drift.
(3) Top of Gabion Baskets to be placed at the level of stream bed.
(4) Dimension 'A' - 1m - 1.5m depending on scour risk.
(5) Dimension 'B' - 0.7m - 1m depending on scour risk.
(6) Drift running width to be same as road width.
(7) Gabions may be substituted by masonry or concrete cut-off walls.

KEY

- Mortared Masonry
- Gabion basket
- Grouted stone pitching on a concrete bed
- Firm foundation existing ground

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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B					
A					

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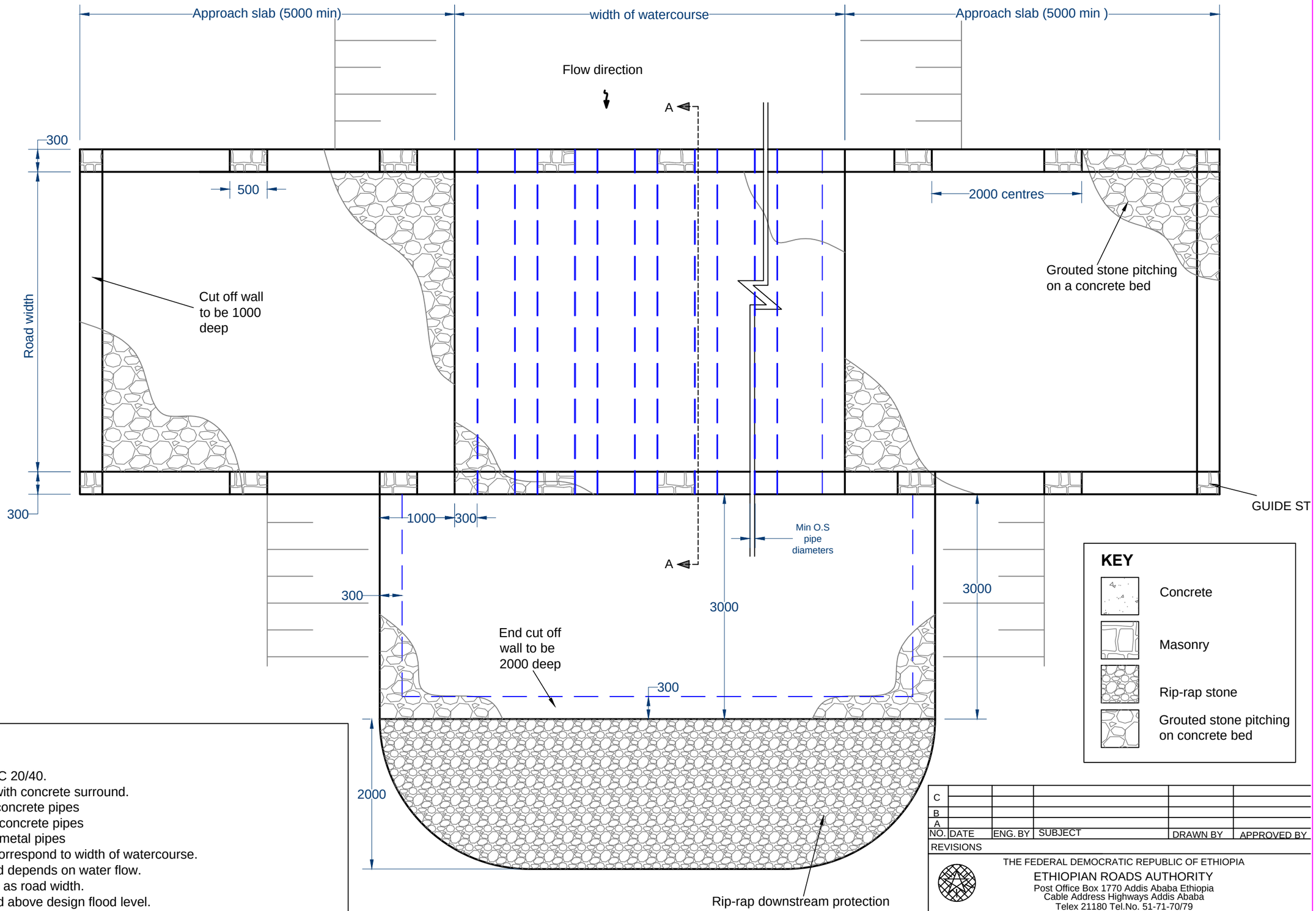
Grouted Stone Pitched Drift with Gabion Baskets

DRAWN	SCALE: 1:50 (at A3)	DRAWING NUMBER
DESIGNED		D-18
CHECKED		
APPROVED B. JEBESSA	DATE: December 2011	
EDITED S. KIRSTEN		



KEY

- Concrete
- Masonry
- Rip-rap stone
- Grouted stone pitching on concrete bed

NOTES:

(1) All dimensions in mm.
(2) All concrete to be Class C 20/40.
(3) Pipes may be-concrete with concrete surround.
- reinforced concrete pipes
- cast in-situ concrete pipes
- corrugated metal pipes

(4) Width of vented ford to correspond to width of watercourse.
(5) Number of pipes required depends on water flow.
(6) Carriageway width same as road width.
(7) Approach slabs to extend above design flood level.
(8) Fill material between pipes to be masonry or lean concrete with plumbs
Fill material on approach embankments to be either of the above or sand and gravel.
(9) Downstream protection to be rip-rap.

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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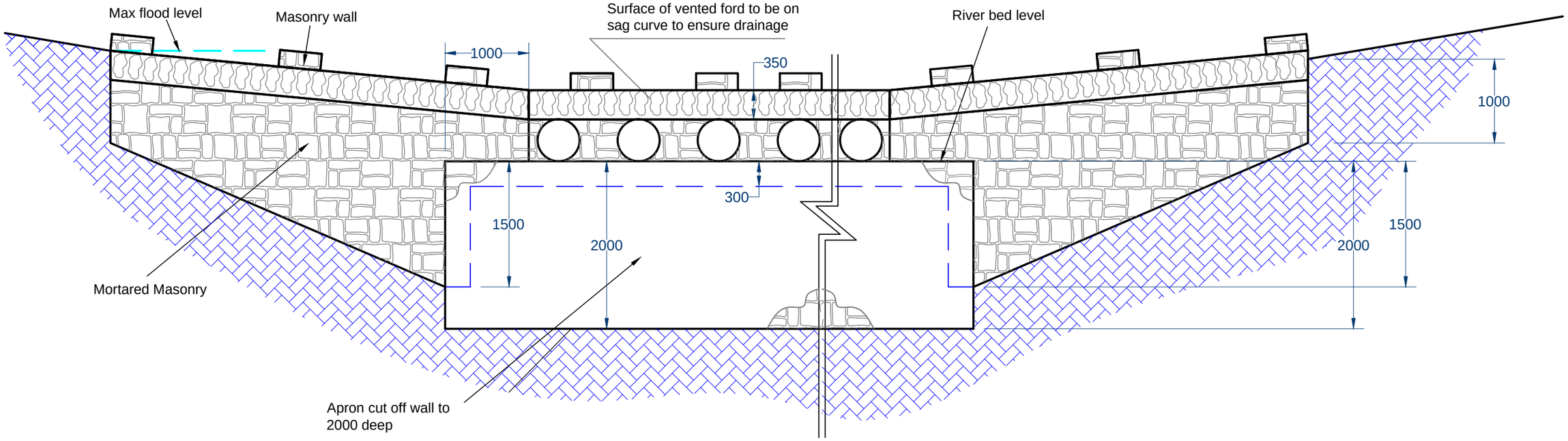
Vented Ford (Plan)

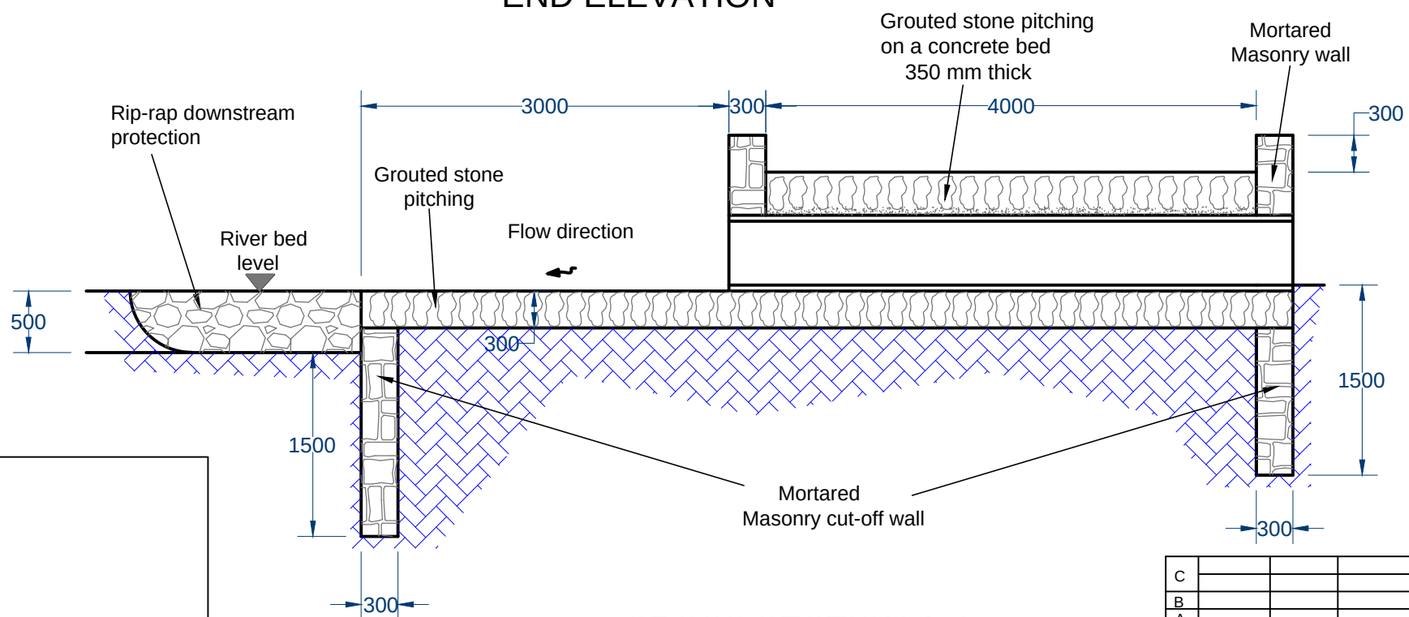
DRAWN		SCALE: 1:50 (at A3)	DRAWING NUMBER
DESIGNED			D-19A
CHECKED		DATE: December 2011	
APPROVED	B. JEBESSA		
EDITED	S. KIRSTEN		



END ELEVATION

KEY

- Firm foundation existing ground
- Concrete
- Masonry
- Rip-rap stone
- Grouted stone pitching



CROSS SECTION A-A

NOTES:

(1) All dimensions in mm.
(2) All concrete to be Class C 20/20.
(3) Pipes may be-concrete with concrete surround.
- reinforced concrete pipes
- cast in situ concrete pipes
- corrugated metal pipes

(4) Width of vented ford to correspond to width of water course.
(5) Number of pipes required depends on water flow.
(6) Carriageway width may be varied according to national standards.
(7) Approach slabs to extended above design flood level.
(8) Fill material between pipes to be rubble masonry or lean concrete with plumbs
Fill material on approach embankments to be either of the above or sand and gravel.
(9) Downstream protection to be specified by the engineer.

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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B					
A					

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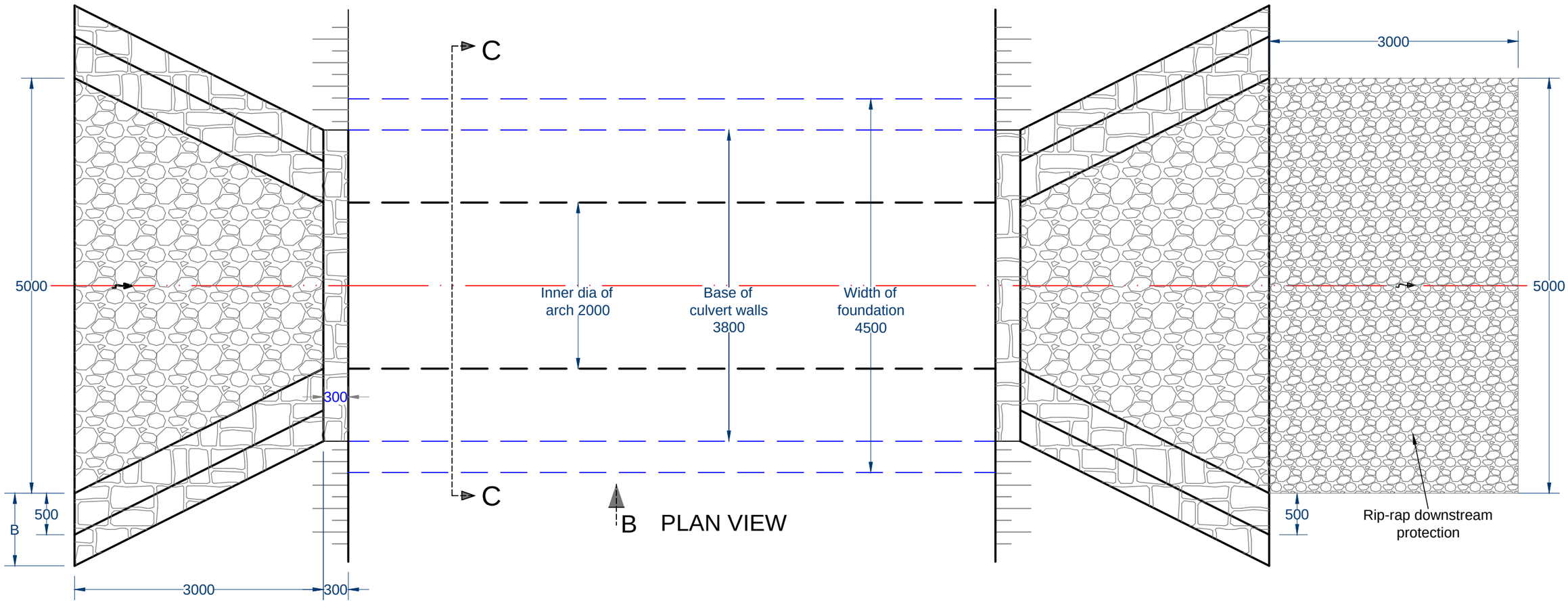
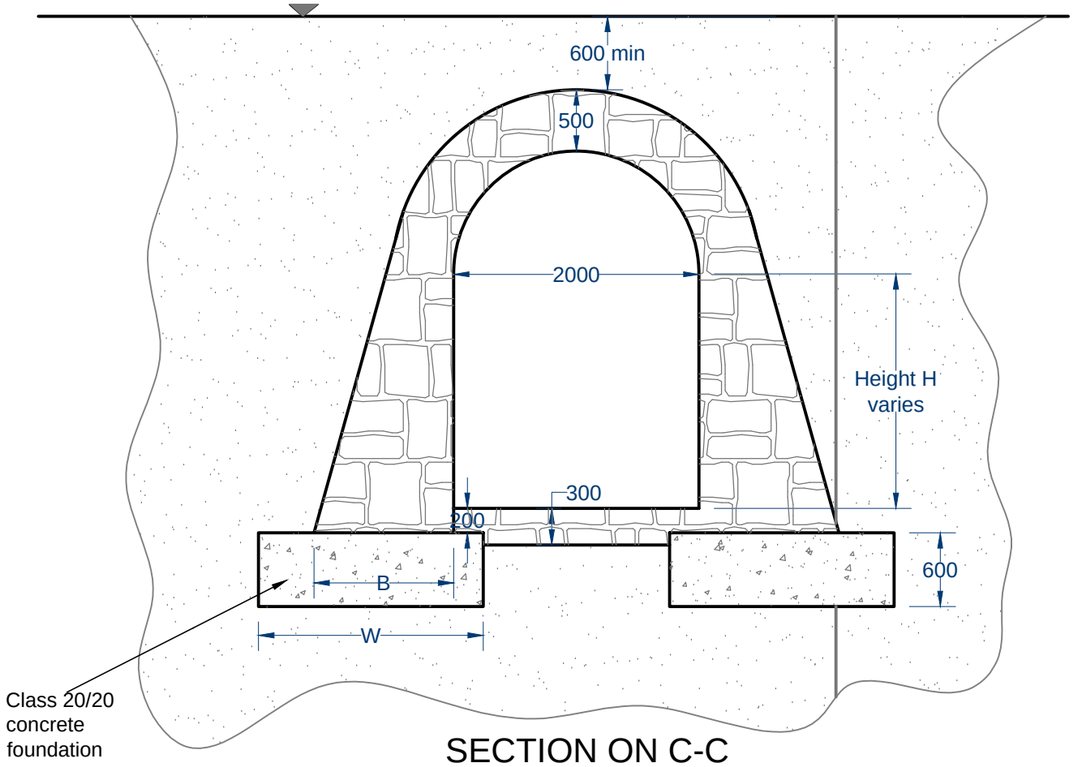
Vented Ford (Elevation and Section)

DRAWN		SCALE: 1:50 (at A3)	DRAWING NUMBER
DESIGNED			D-19B
CHECKED		DATE: December 2011	
APPROVED	B. JEBESSA		
EDITED	S. KIRSTEN		





SECTION ON C-C

Height from culvert foundation to arch springing = H
Culvert wall thickness at base = B = 500 + H/4
Width of foundation = W = H

NOTES:
(1) All dimensions in mm.
(2) Masonry in arch : Longest dimension of stone to be placed in a radial direction.
(3) Foundation size may be increased for ground with low bearing capacity.
(4) Invert of culvert barrel may be curved to improve low water flows.
(5) Backfill material behind and above arch to be graded material compacted in 300 mm layers.
(6) Culvert wing walls flare may be altered according to width of watercourse.
(7) Culvert inlet and outlet details are similar.
(8) Maximum height shall be 2.5m.

KEY

Concrete
Masonry
Selected fill material
Rip-rap stone

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

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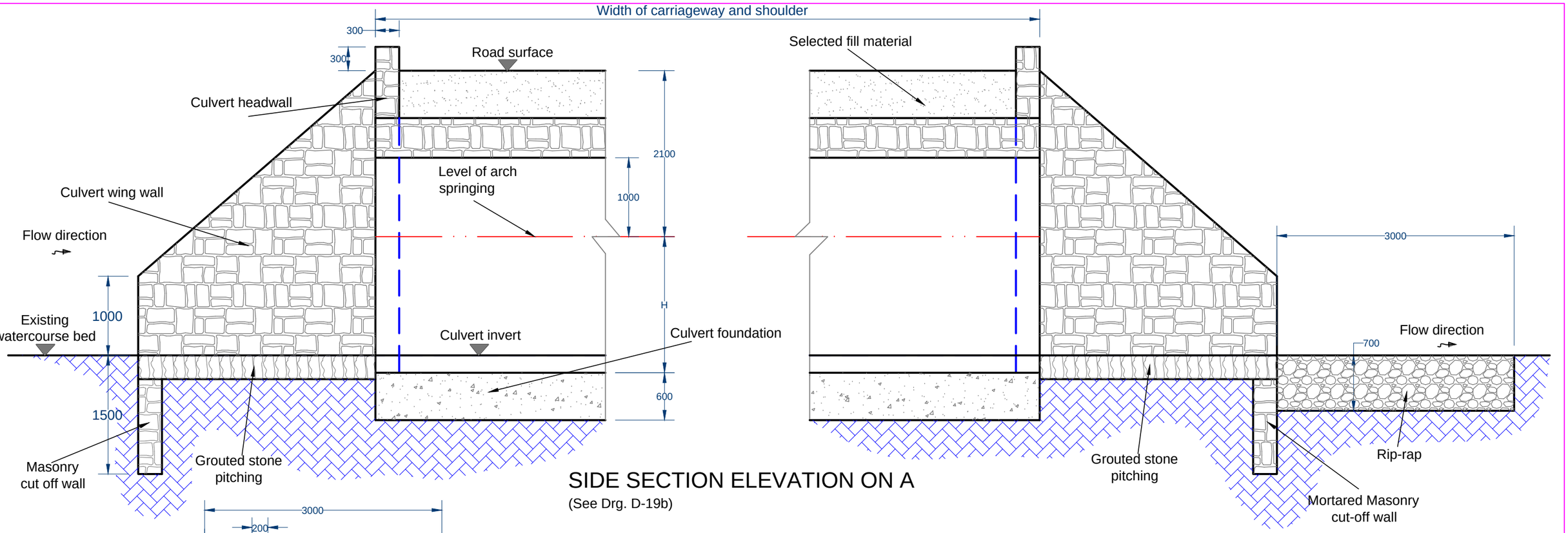
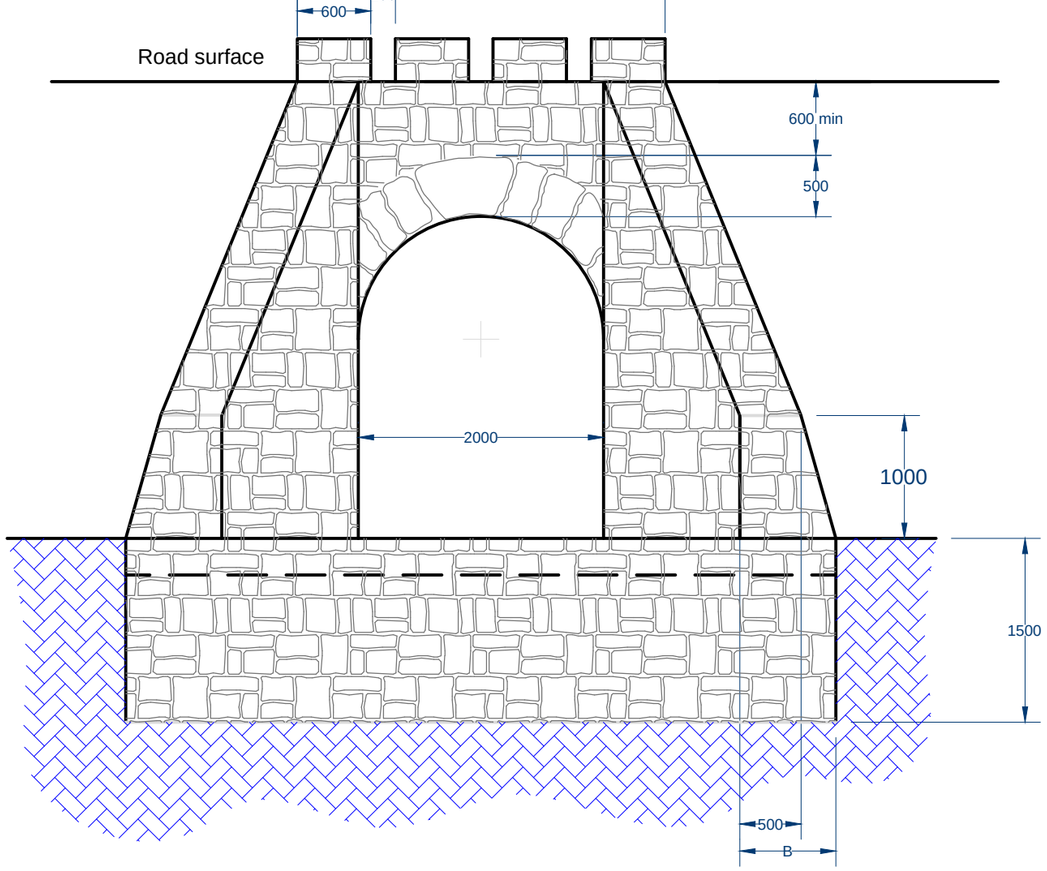
Masonry Arch Culvert (Plan)

DRAWN	SCALE: 1:50 (at A3)	DRAWING NUMBER
DESIGNED		D-20A
CHECKED		
APPROVED B. JEBESSA	DATE: December 2011	
EDITED S. KIRSTEN		





SIDE SECTION ELEVATION ON A

(See Drg. D-19b)

Height from culvert foundation to arch springing = H
Culvert wall thickness at base = B = 500 + H/4
Width of foundation = W = H

NOTES:
(1) All dimensions in mm.
(2) Masonry in arch : Longest dimension of stone to be placed in a radial direction.
(3) Foundation size may be increased for ground with low bearing capacity.
(4) Invert of culvert barrel may be curved to improve low water flows.
(5) Backfill material behind and above arch to be graded material compacted in 300 mm layers.
(6) Culvert wing walls flare may be altered according to width of watercourse.
(7) Culvert inlet and outlet details are similar.

Please read this drawing together with drawing. No. D-19b

KEY

- Concrete
- Masonry
- Firm foundation / Existing ground
- Rip-rap stone
- Selected fill material
- Grouted stone pitching

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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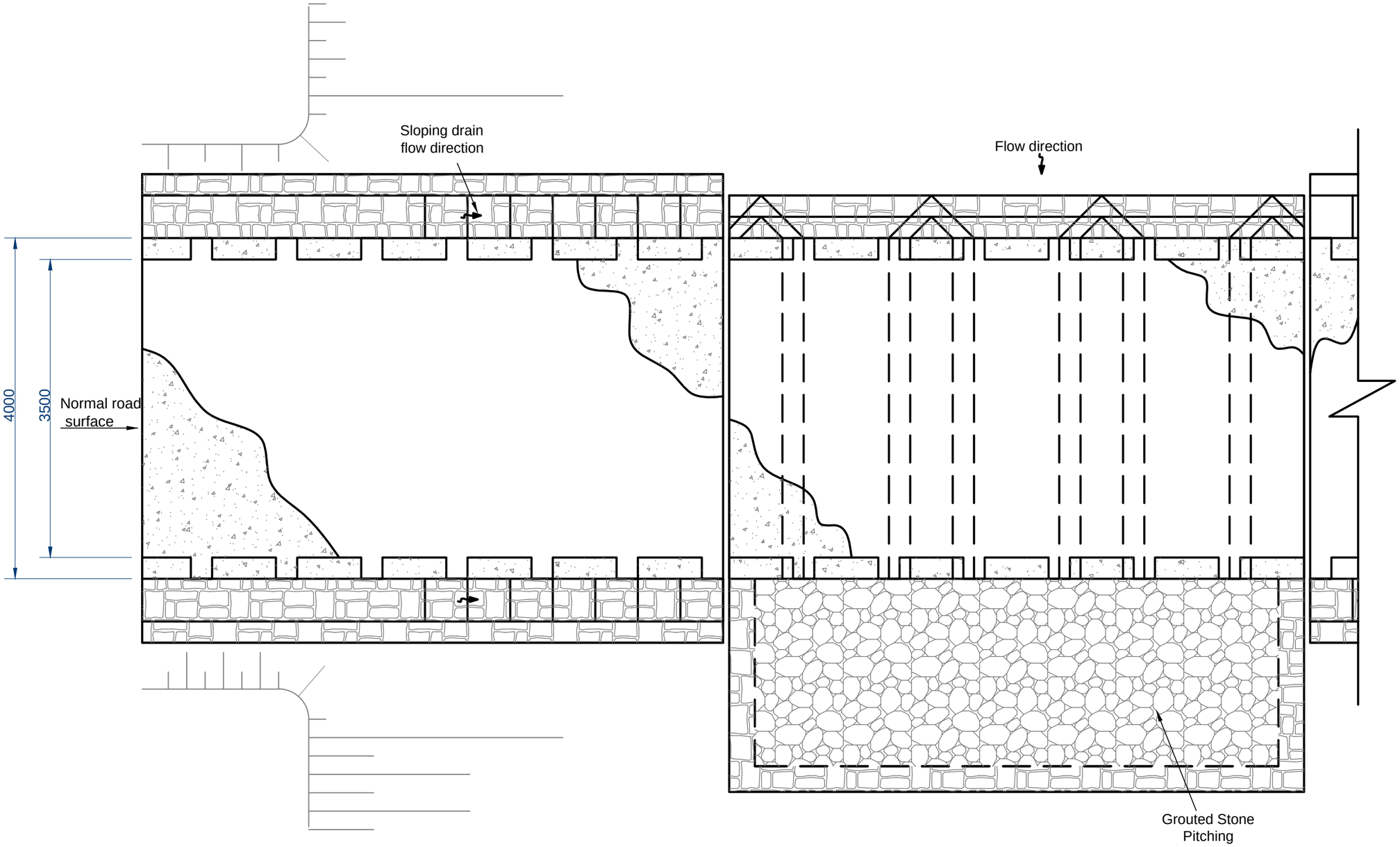
Masonry Arch Culvert (Elevation)

DRAWN	SCALE: 1:50 (at A3)	DRAWING NUMBER
DESIGNED		D-20B
CHECKED	DATE: December 2011	
APPROVED B. JEBESSA		
EDITED S. KIRSTEN		



PLAN VIEW

NOTES:
(1) All dimensions in mm.
(2) Number of arches may be increased for wider watercourse.
(3) Design flood level to be below carriageway level.
(4) Arches may be constructed from corrugated steel sheets for masonry (corrugated steel shown).
(5) Fill material above arches to be rubble masonry or lean concrete with plumbs fill to be placed and compacted in 300mm layers evenly on each side of arch.
(6) Base slab and downstream apron to be continuous.

KEY

Concrete

Mortared Masonry

Mortared stone pitching

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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B					
A					

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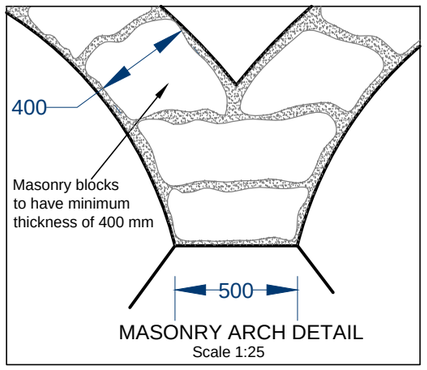
Large Multi-bore Culvert (Plan)

DRAWN	SCALE: 1:50 (at A3)	DRAWING NUMBER
DESIGNED		D-21A
CHECKED		
APPROVED B. JEBESSA	DATE: December 2011	
EDITED S. KIRSTEN		

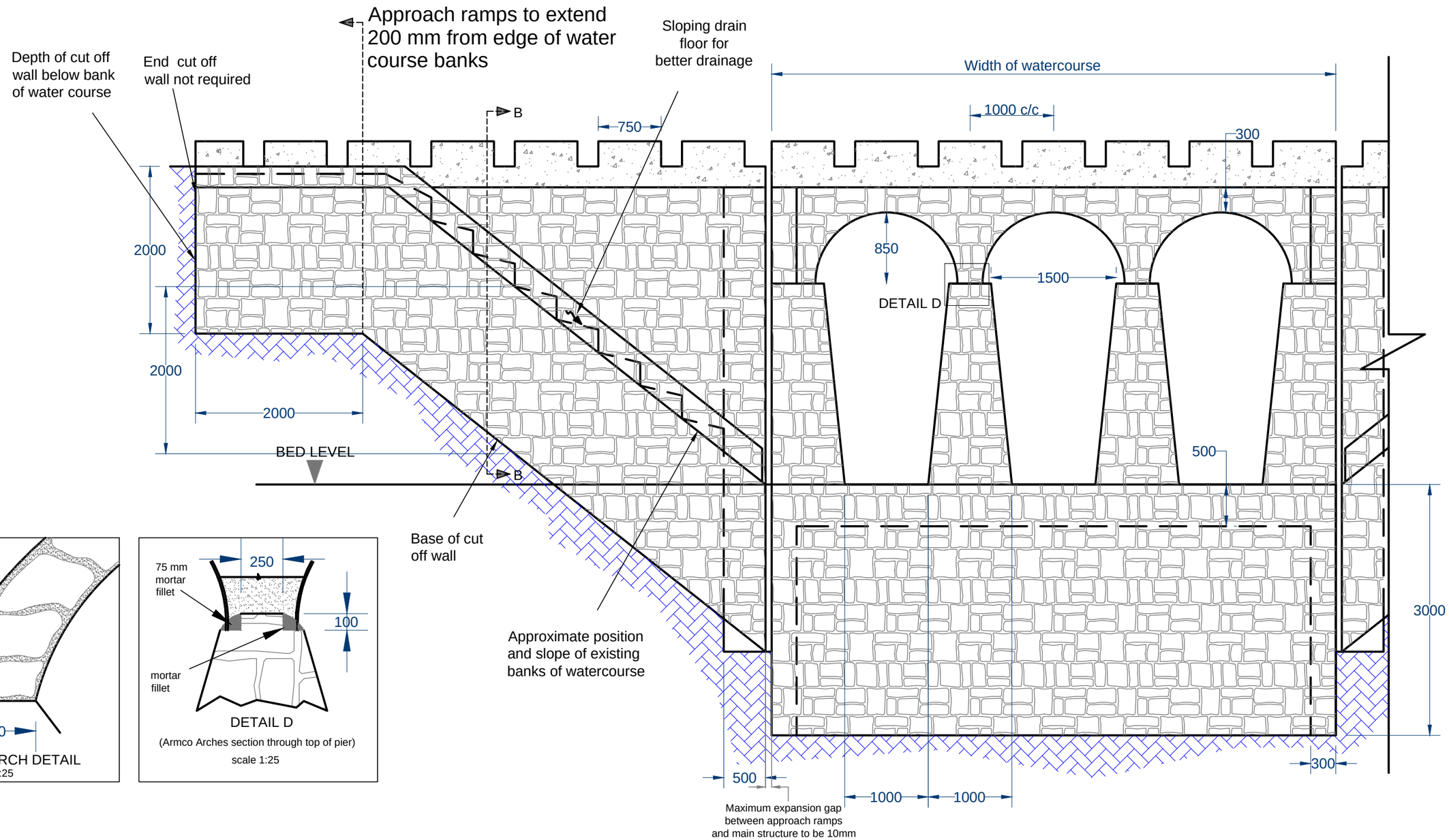


MASONRY ARCH DETAIL
Scale 1:25

DETAIL D

(Armco Arches section through top of pier)

scale 1:25



FRONT ELEVATION ON A

NOTES:

(1) All dimensions in mm.
(2) Number of arches may be increased for wider watercourse.
(3) Design flood level to be below carriageway level.
(4) Arches may be constructed from corrugated steel sheets for masonry (corrugated steel shown).
(5) Fill material above arches to be rubble masonry or lean concrete with plumbs fill to be placed and compacted in 300mm layers evenly on each side of arch.
(6) Base slab and downstream apron to be continuous.

KEY

- Concrete
- Mortared Masonry
- Firm foundation/ Existing ground

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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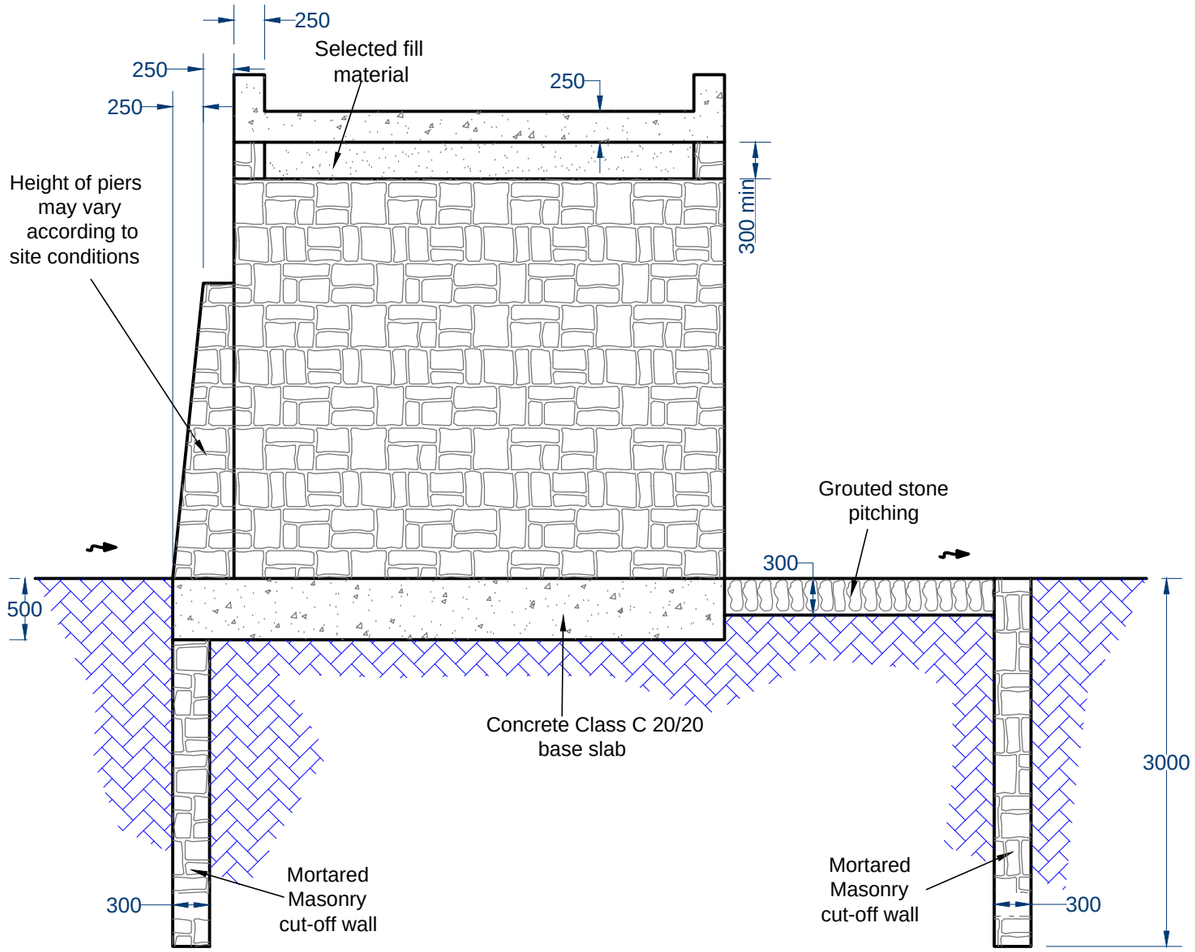
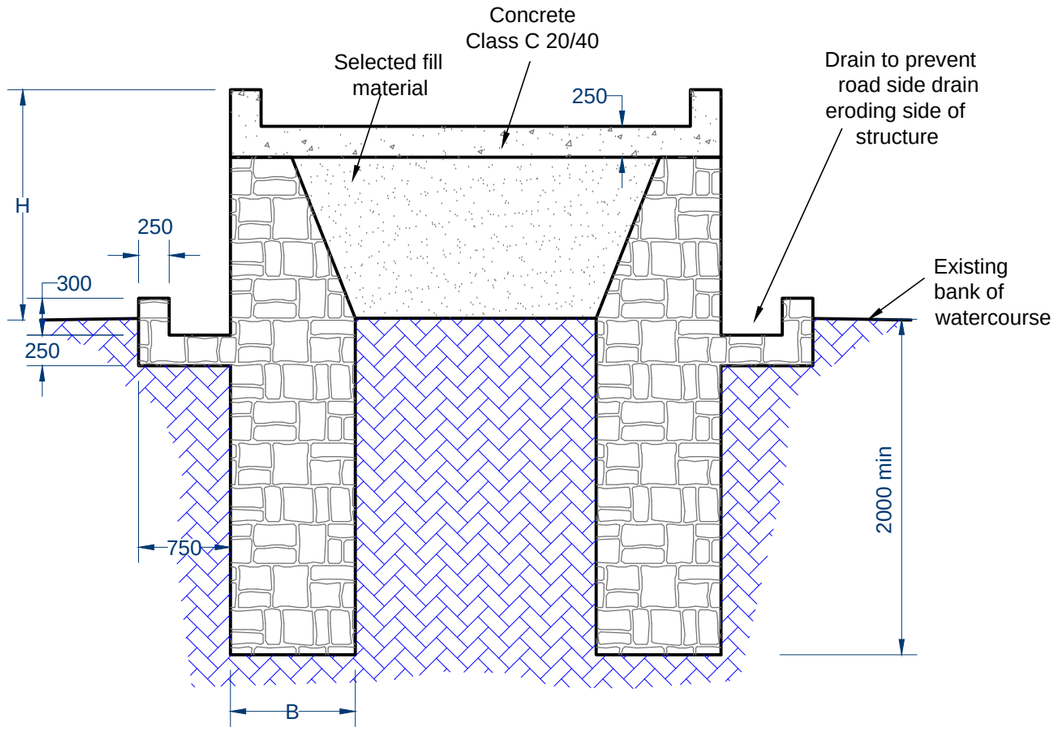
Large Multi-bore Culvert (Elevation)

DRAWN		SCALE: 1:50 (at A3)	DRAWING NUMBER
DESIGNED			D-21B
CHECKED		DATE: December 2011	
APPROVED	B. JEBESSA		
EDITED	S. KIRSTEN		



CROSS SECTION A-A



CROSS SECTION B-B

NOTES:
(1) All dimensions in mm.
(2) Number of arches may be increased for wider watercourse.
(3) Design flood level to be below carriageway level.
(4) Arches may be constructed from corrugated steel sheets for masonry (corrugated steel shown).
(5) Fill material above arches to be rubble masonry or lean concrete with plumbs fill to be placed and compacted in 300mm layers evenly on each side of arch.
(6) Base slab and downstream apron to be continuous.

KEY

- Concrete
- Mortared Masonry
- Firm foundation/ Existing ground
- Fill material
- Grouted stone pitching

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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B					
A					

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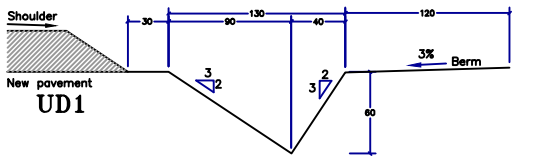
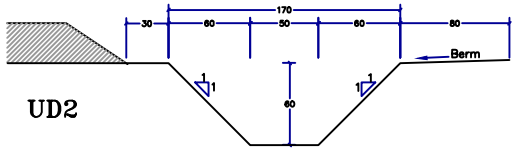
Large Multi-bore Culvert (Cross Section)

DRAWN	SCALE: 1:50 (at A3)	DRAWING NUMBER
DESIGNED		D-21c
CHECKED		
APPROVED B. JEBESSA	DATE: December 2011	
EDITED S. KIRSTEN		

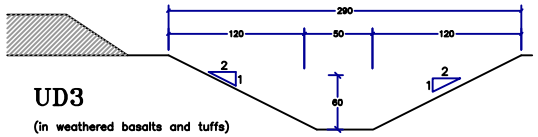
TYPICAL DITCHES

UNLINED DITCHES

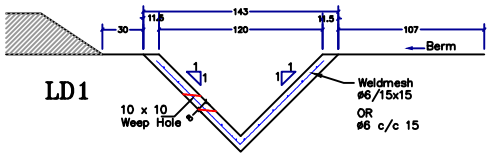


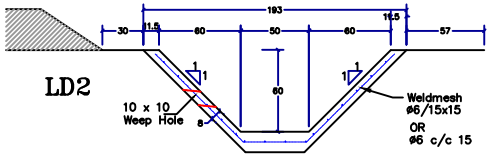


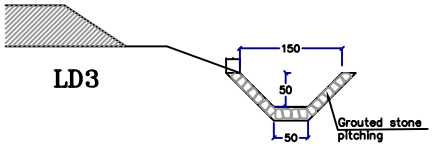
EMBANKMENT DITCH

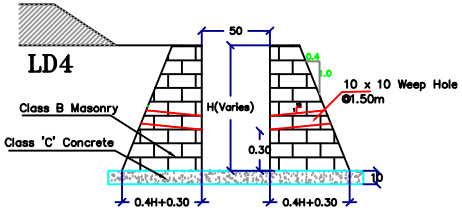


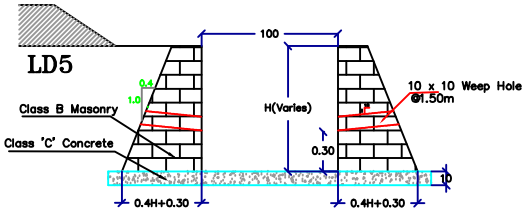
LINED DITCHES

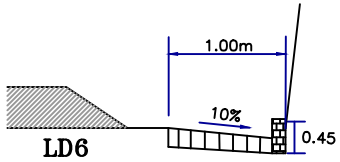












Notes:

TYPE ''LD3" Trapezoidal paved waterway must be used where road sections in heavy cut section in earth and grade exceeds 5%.

TYPE ''LD4" & ''LD5" Masonry paved waterway for Town sections. In Town Sections, roadside drainage may include lined ditches, pedestrian crossing ditch cover slabs, and piped ditch crossings for side road or vehicle access Connections only where considered necessary and directed by the Engineer.

TYPE ''LD6" paved waterway must be used to back on retaining wall.

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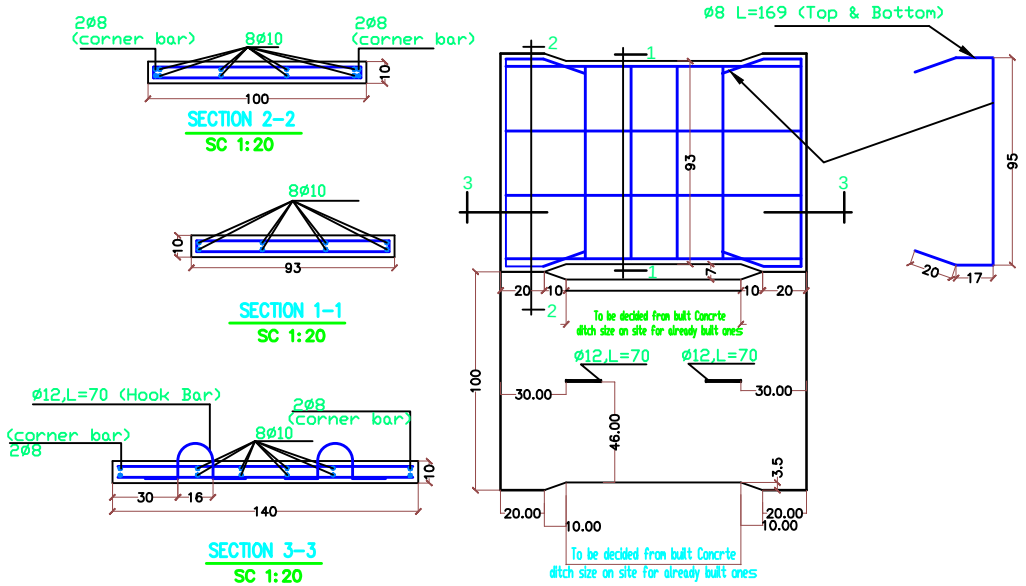
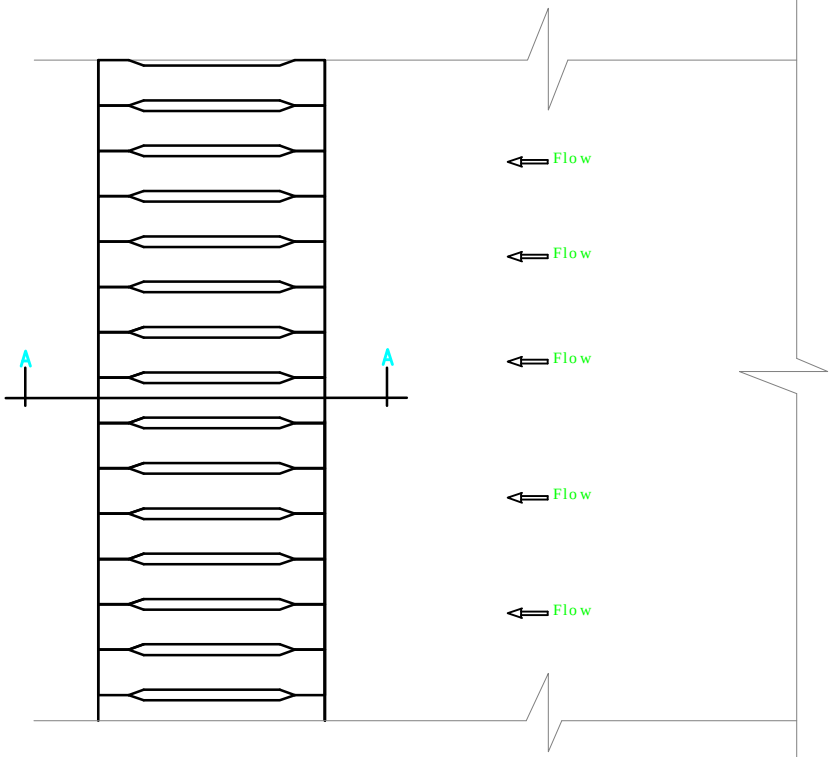
SIDE DITCH TYPE AND DETAIL

DRAWN	DY	SCALE:	DRG. NO.
DESIGNED	BJ	AS SHOWN	G – 01a
CHECKED	BJ	DATE	
EDITED	SJURSTEN	15/06/2015	
APPROVED			

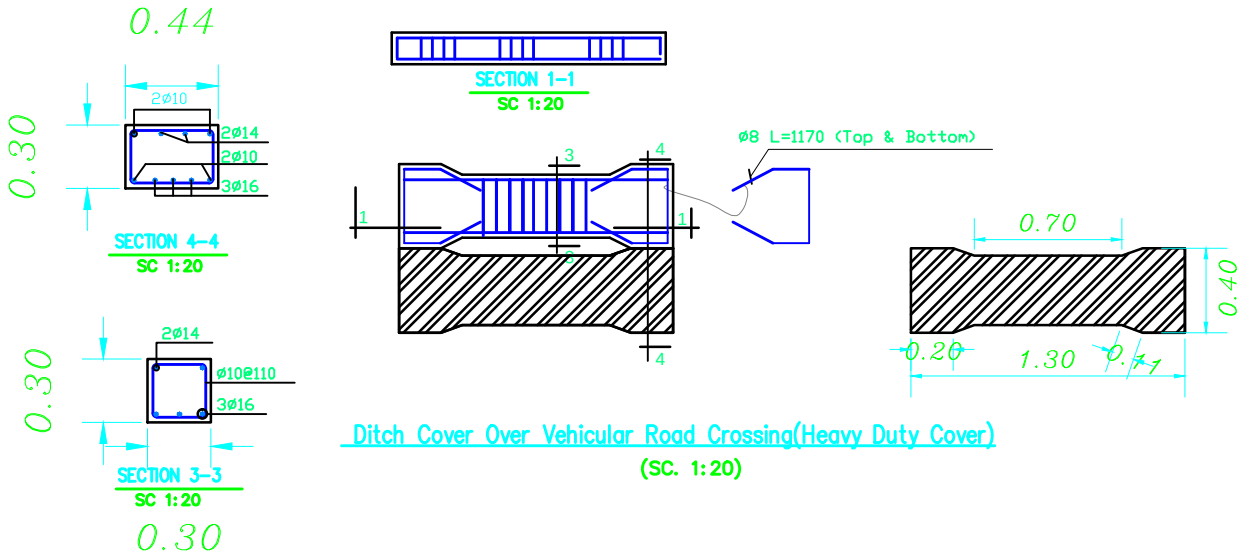
Detail to Town Ditch



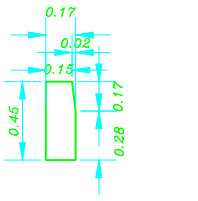
Pre Cast Concrete Pedestrian Ditch Cover



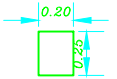
Ditch Cover Over Vehicular Road Crossing Plan
(SC. 1:20)



Ditch Cover Over Vehicular Road Crossing(Heavy Duty Cover)
(SC. 1:20)



Concrete Curb
On carriageway side



Concrete Curb
Edge curb

Notes:

Ditch cover slabs shall be provided throughout the side drain of Wereda seats.

In Kebele seats ditch cover slabs shall be provided at all access locations and other sections only where considered necessary and directed by the Engineer.

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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B					
A					

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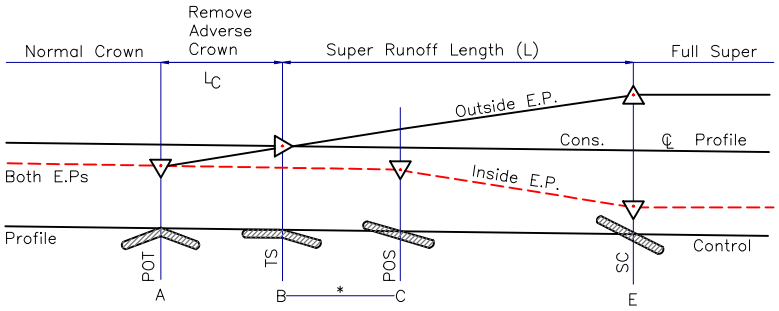
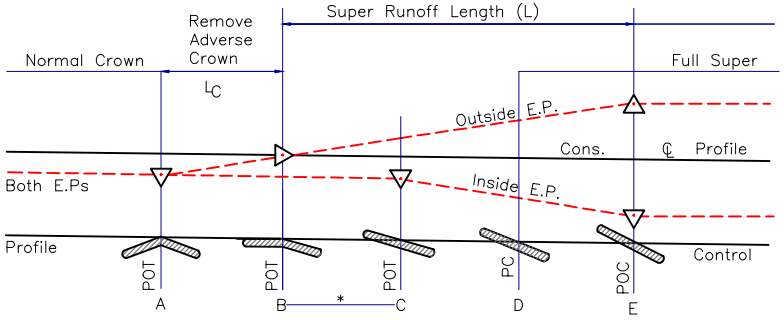
SIDE DITCH COVER SLAB DETAIL

DRAWN	DY	SCALE:	DRG. NO.
DESIGNED	BJ	AS SHOWN	G – 01b
CHECKED	BJ	DATE	
EDITED	S.KIRSTEN	15/06/2015	
APPROVED			

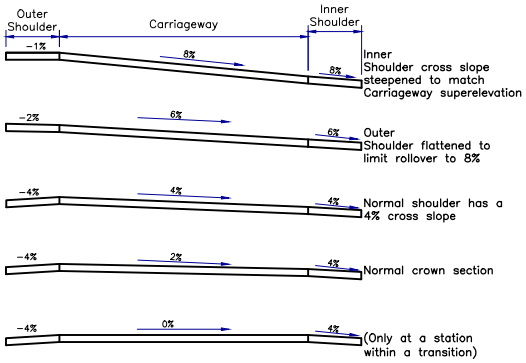


Spiral Curve Transition



Circular Curve Transition

TYPICAL SHOULDER SUPERELEVATIONS
FOR SURFACED ROADS



A is point at which adverse crown removal begins.
B is point at which superelevation transition begins.
C is point of equality between superelevation and normal crown.
D is P.C. location for circular curve transition.
E is the point at which full superelevation is reached.

*Distance BC = (NC)(L)/e

EP = Edge of Pavement
Lc = Length to remove adverse crown
POT = Point on Tangent
TS = Tangent to spiral
POS = Point of spiral
SC = Spiral to circular curve
PC = Point of circular curve

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

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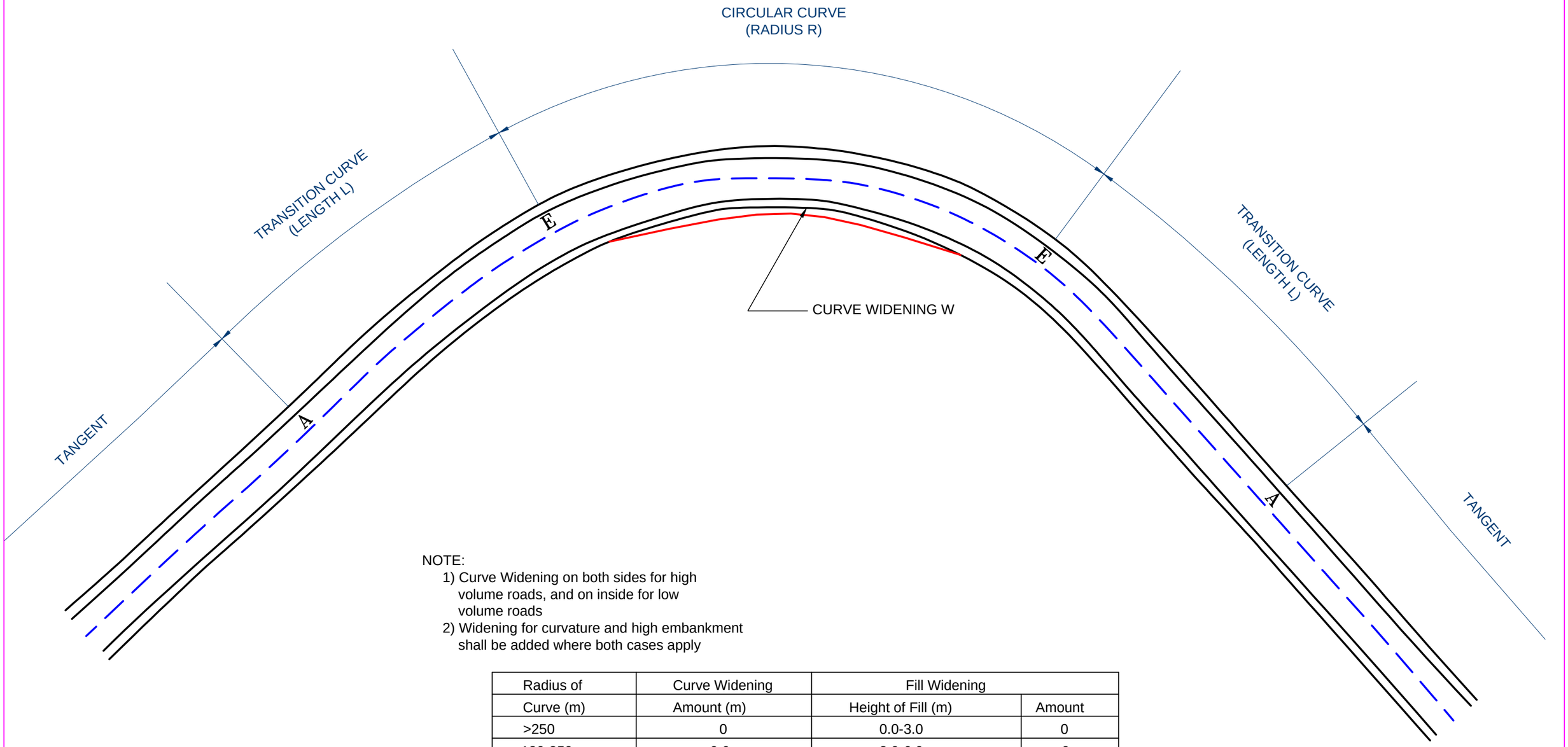
Telex 21180 Tel.No. 51-71-70/79

SUPERELEVATION DEVELOPMENT

DRAWN	RAHEL LEMMA	SCALE:	DRG. NO.
DESIGNED	MICHAEL S. NYQUIST	AS SHOWN	G – 02
CHECKED	MICHAEL S. NYQUIST	DATE	
EDITED	S.JORSTEN	019/11/98	
APPROVED	B.JEBESSA		



NOTE:

1) Curve Widening on both sides for high volume roads, and on inside for low volume roads
2) Widening for curvature and high embankment shall be added where both cases apply

Radius of	Curve Widening	Fill Widening	
Curve (m)	Amount (m)	Height of Fill (m)	Amount
>250	0	0.0-3.0	0
120-250	0.6	3.0-6.0	0
60-120	0.9	6.0-9.0	0.6
40-60	1.2	Over 9.0	0.9
20-40	1.5	Over 9.0	0.9

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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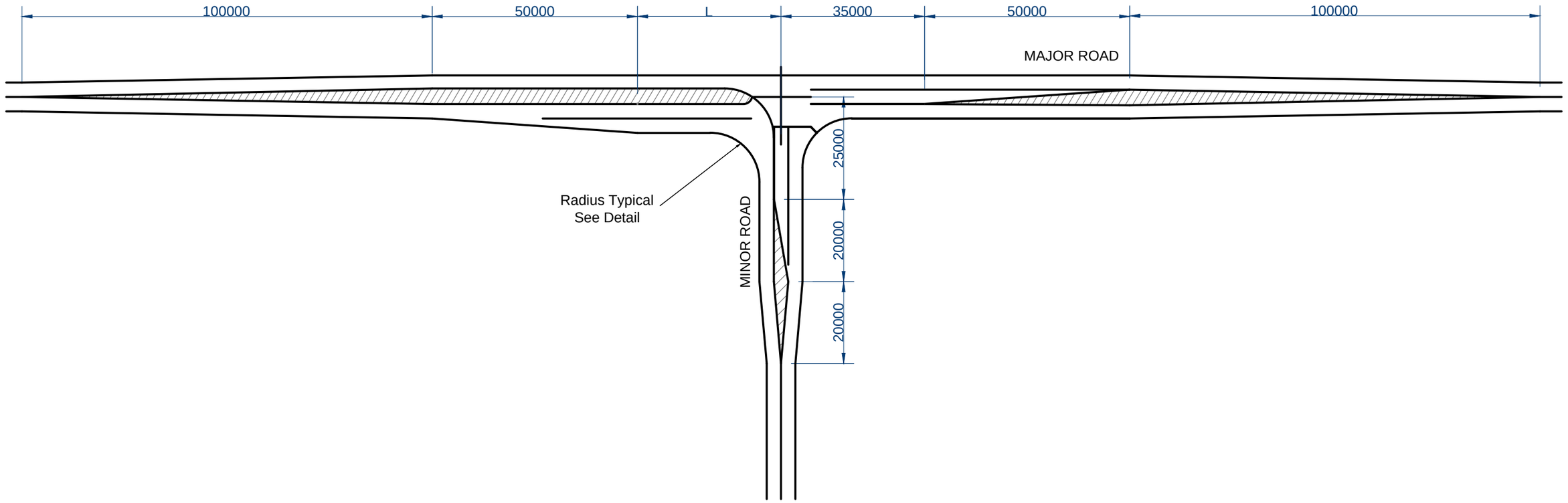
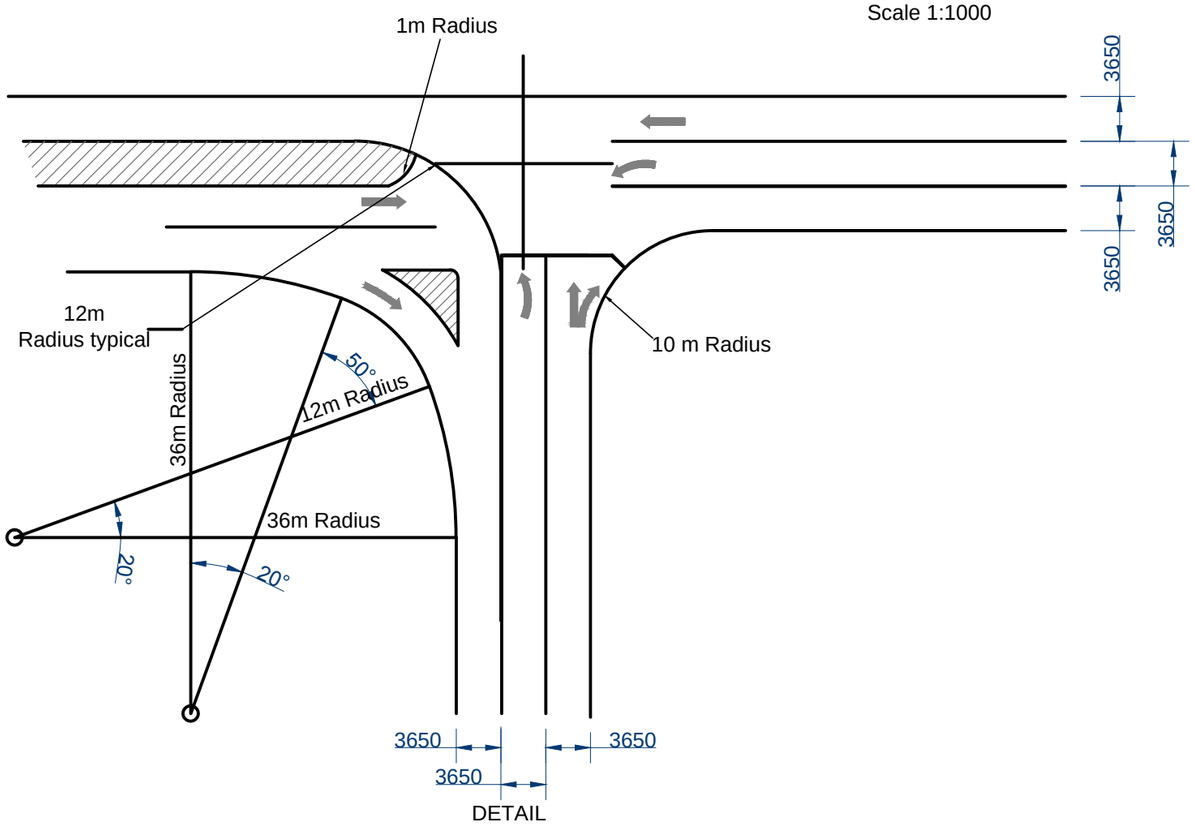
CURVE AND FILL WIDENING

DRAWN		SCALE: As shown (at A3)	DRAWING NUMBER
DESIGNED			G-03
CHECKED		DATE: December 2011	
APPROVED	B. JEBESSA		
EDITED	S. KIRSTEN		



STANDARD T- JUNCTION

Scale 1:1000



DETAIL

Scale 1:500

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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B					
A					

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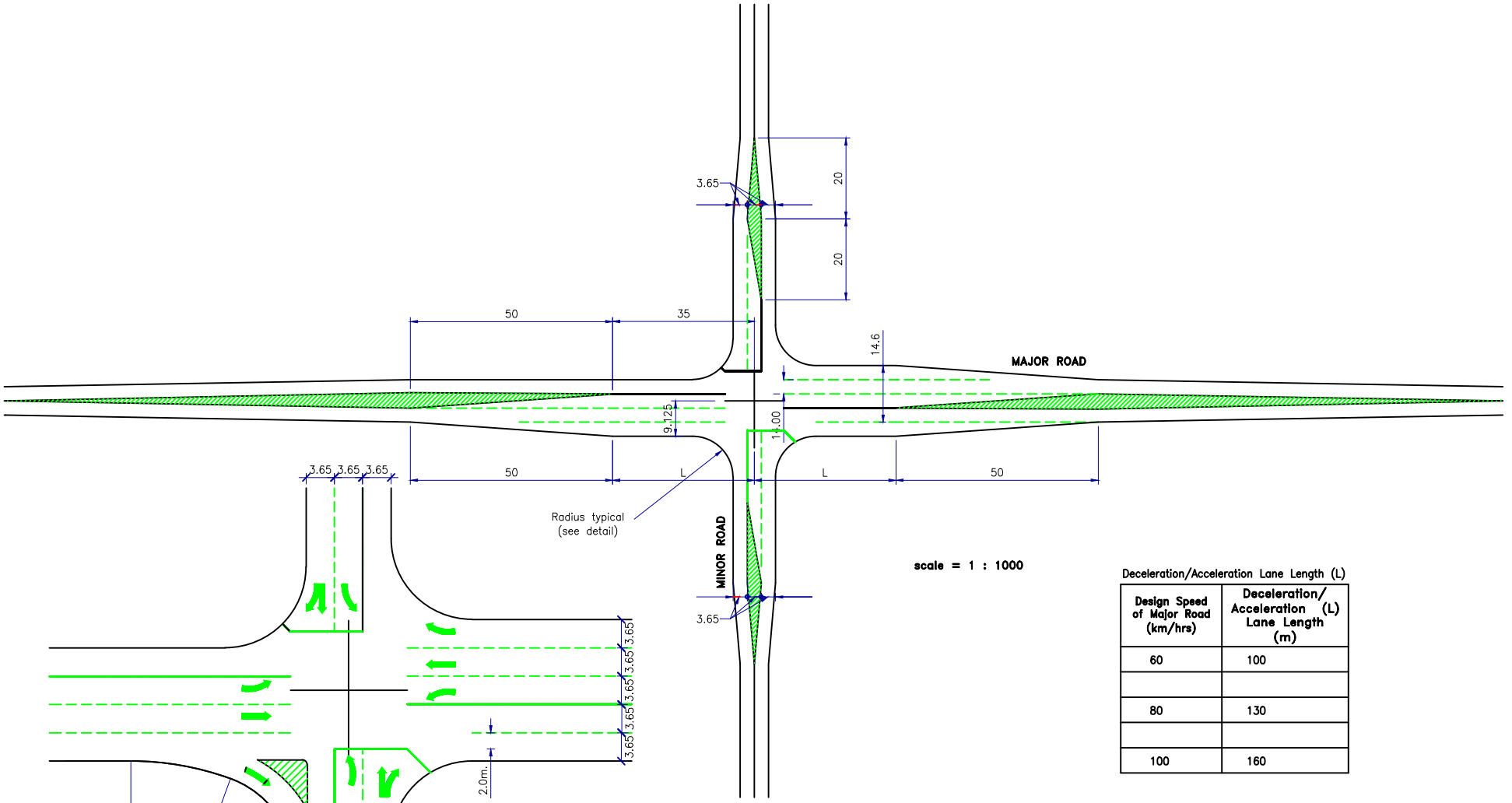
STANDARD T - JUNCTION TYPE A

DRAWN	SCALE: As shown (at A3)	DRAWING NUMBER
DESIGNED		G-04
CHECKED		
APPROVED B. JEBESSA	DATE: December 2011	
EDITED S. KIRSTEN		



scale = 1 : 1000

scale = 1 : 500

Deceleration/Acceleration Lane Length (L)

Design Speed of Major Road (km/hrs)	Deceleration/ Acceleration (L) Lane Length (m)
60	100
80	130
100	160

STANDARD CROSS JUNCTION

HIGH VOLUME ROADS

NOTE : A STAGGERED JUNCTION IS THE OPTION PREFERRED OVER A CROSS JUNCTION. USE CROSS JUNCTIONS ONLY WHERE CONDITIONS PROHIBIT THE USE OF A STAGGERED JUNCTION.

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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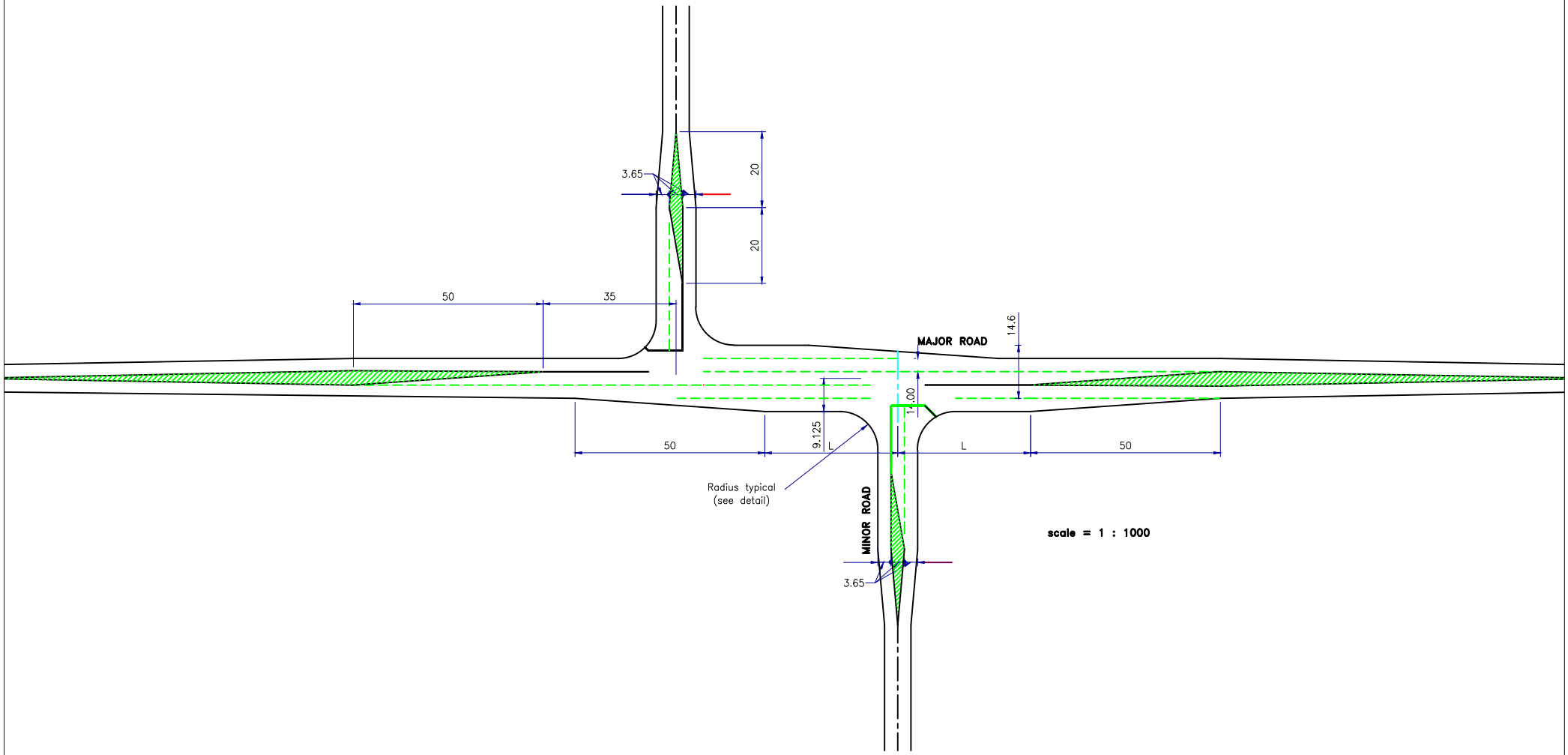
CROSS – JUNCTION

DRAWN	RAHEL LEMMA	SCALE:	DRG. NO.
DESIGNED	MICHAEL S. NYQUIST	AS SHOWN	G – 05A
EDITED	S.KIRSTEN	DATE	
APPROVED	B.JEBESSA	019/11/98	
APPROVED			



STAGGERED JUNCTION

HIGH VOLUME ROADS

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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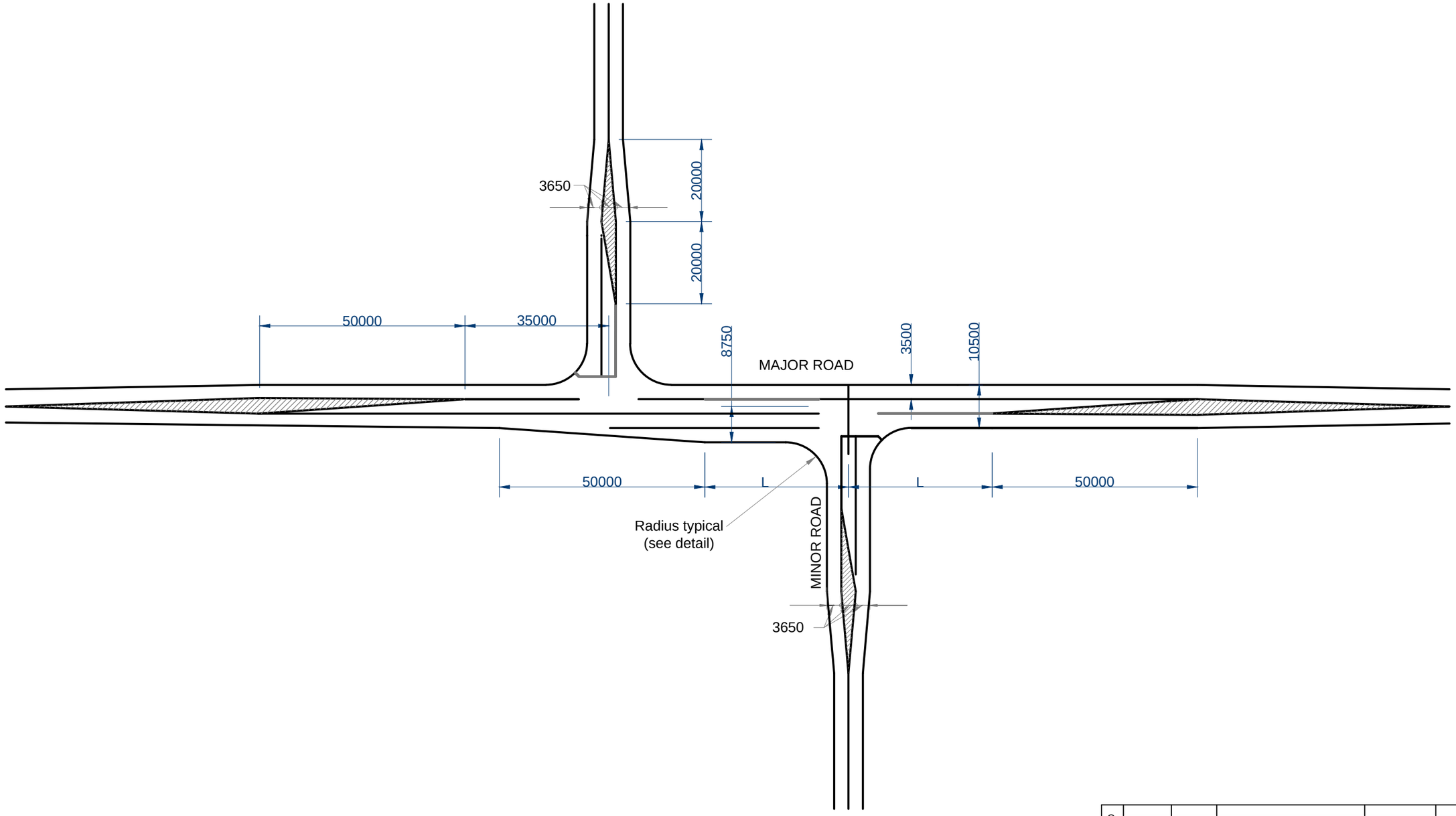
CROSS – JUNCTION

DRAWN	RAHEL LEMMA	SCALE: AS SHOWN	DRG. NO. G – 05B
DESIGNED	MICHAEL S. NYQUIST		
EDITED	S.JORSTEN	DATE 18/01/02	
APPROVED	B.JEBESSA		
APPROVED			



STAGGERED JUNCTION

HIGH VOLUME ROADS

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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A					

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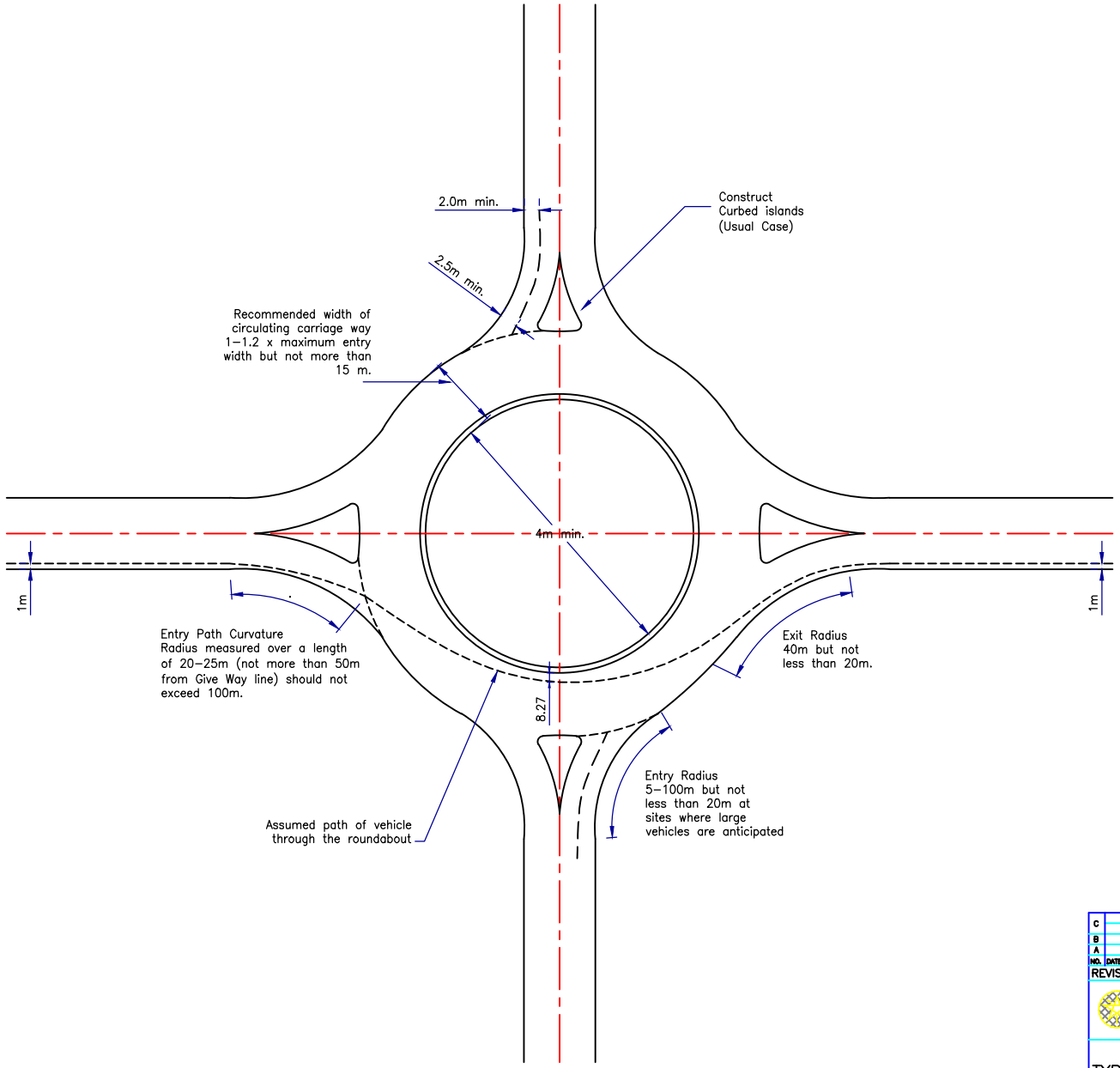
STANDARD CROSS - JUNCTION
Rural Area Type B

DRAWN		SCALE: 1:1000 (at A3)	DRAWING NUMBER
DESIGNED			G-05
CHECKED		DATE: December 2011	
APPROVED	B. JEBESSA		
EDITED	S. KIRSTEN		



Scale 1 : 500

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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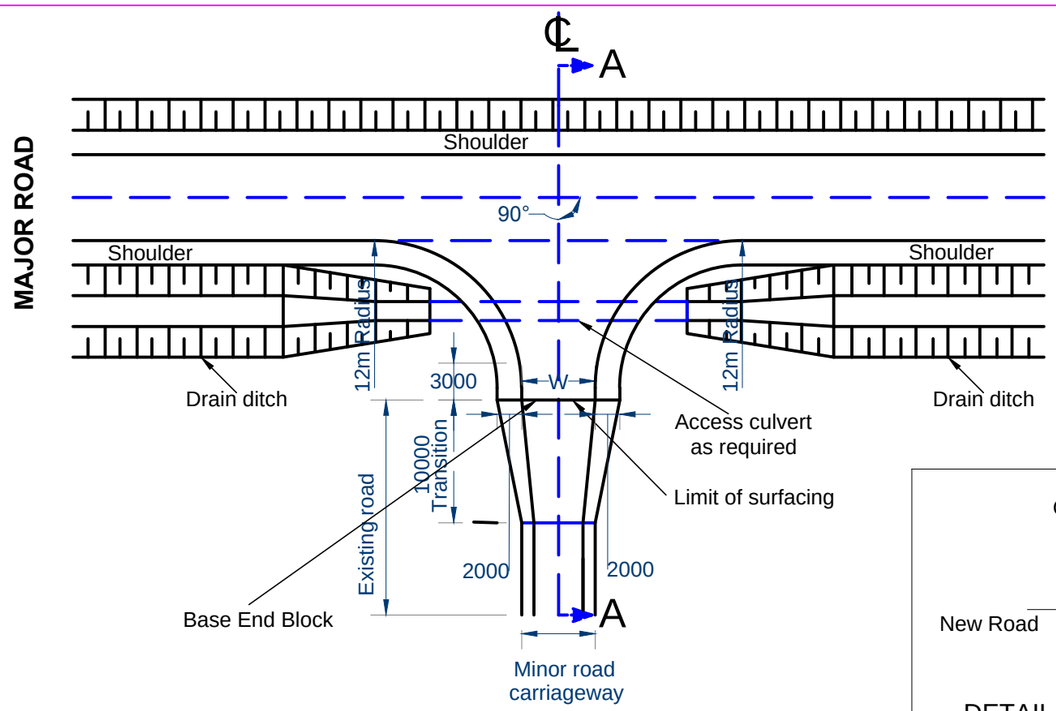
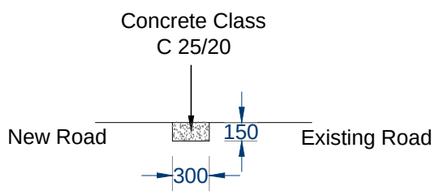
TYPICAL ROUNDABOUT

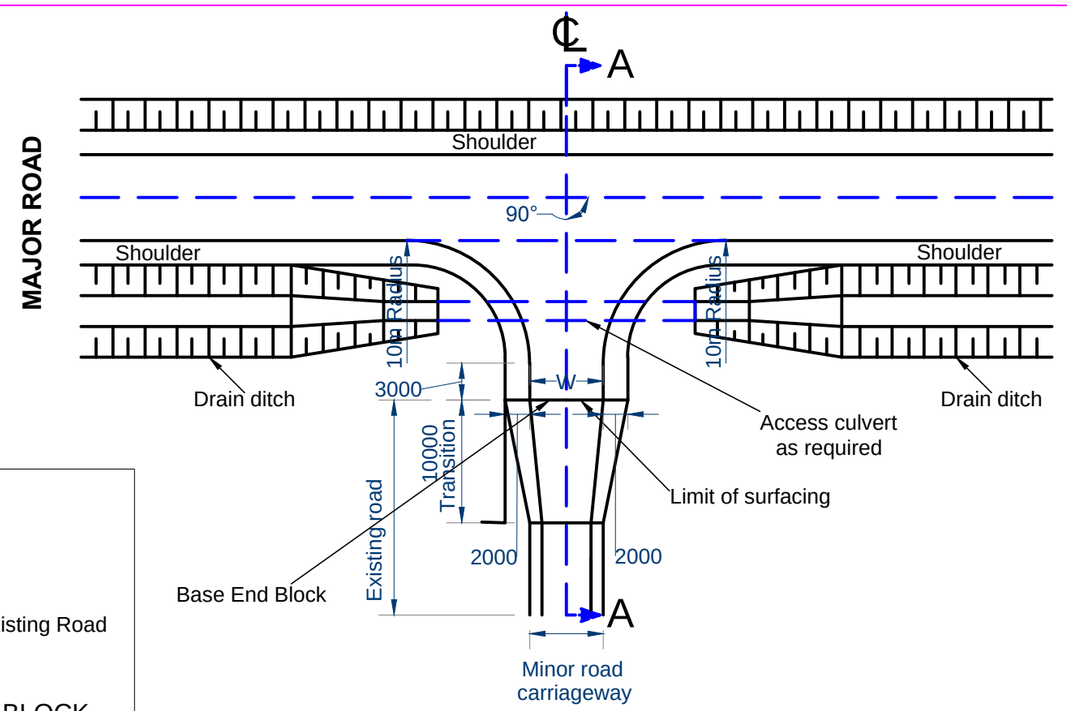
DRAWN	RAHEL LEMMA	SCALE:	DRG. NO.
DESIGNED	MICHAEL S. NYQUIST	AS SHOWN	G – 06
EDITED	S.KIRSTEN	DATE	
APPROVED	B.JEBESSA	019/11/98	
APPROVED			



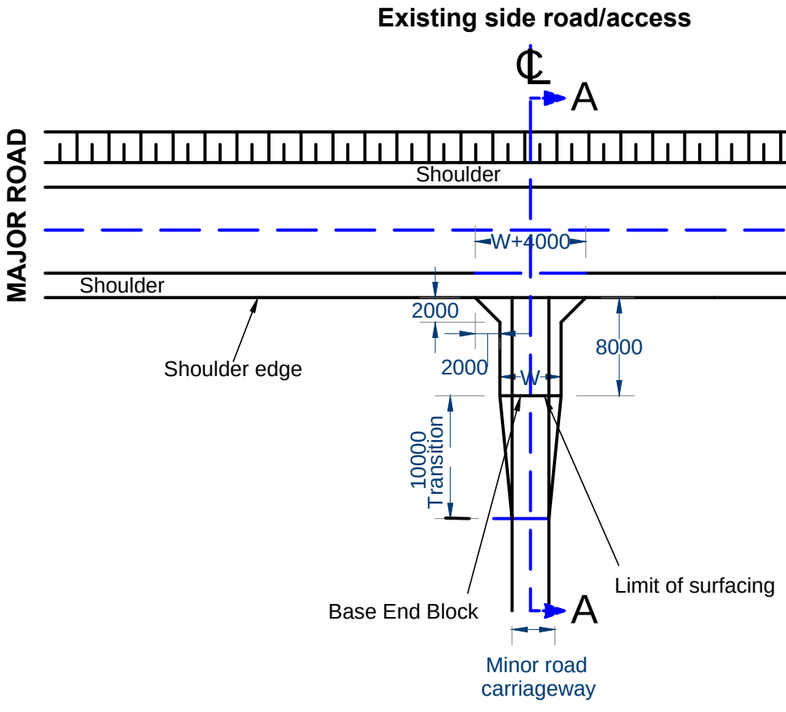
JUNCTION TYPE C



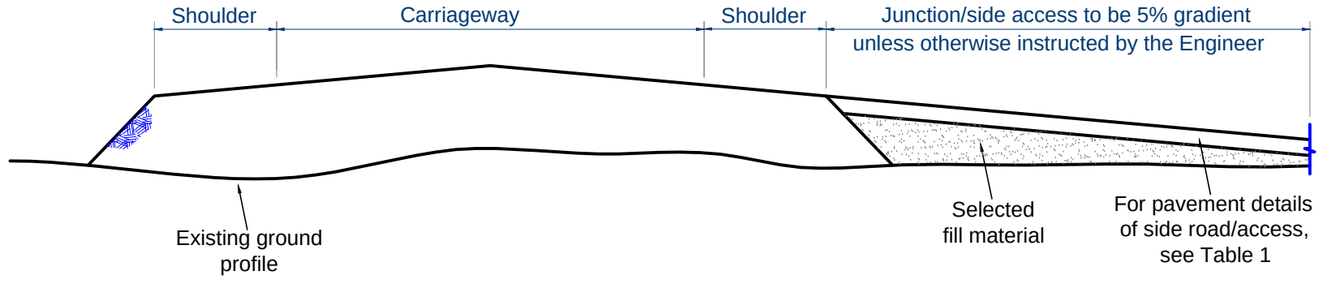
DETAIL FOR BASE END BLOCK



JUNCTION TYPE D



JUNCTION TYPE E



TYPICAL SECTION A-A
Scale 1:100

NOTES:
(1) All dimensions in mm.
(2) Transition length between existing side road/access and proposed road may be amended by the Engineer to suit site condition.

TABLE 1

MAJOR JUNCTION ACCESS TYPE	PAVEMENT STRUCTURE
C	As main way carriageway adjacent
D	As adjacent main carriageway, but improved subgrade material and 175 mm cement lime/improved sub-base to be substituted by 175 mm natural material sub-base (not improved).
E	Single seal surface dressing (pre-coated chipping's) 150 mm graded crushed stone base (untreated) 175 mm natural material sub-base (not improved).

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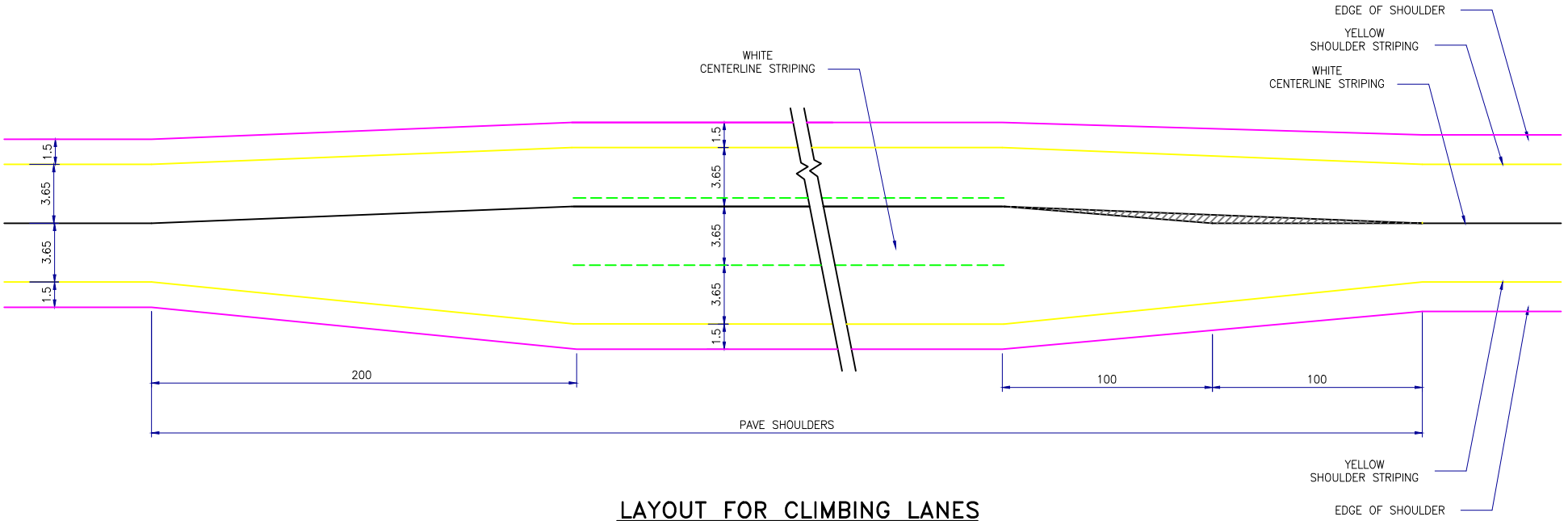
Layout of Rural Road Junctions and Access

DRAWN	SCALE:NTS	DRAWING NUMBER
DESIGNED		G-07
CHECKED		
APPROVED B. JEBESSA	DATE: December 2011	
EDITED S. KIRSTEN		



LAYOUT FOR CLIMBING LANES

Note : Other lane widths and shoulder widths are possible;
See the prevailing version of the ERA Geometric
Design Manual for reference width
Width of all striping is 100 mm.

N.T.S.

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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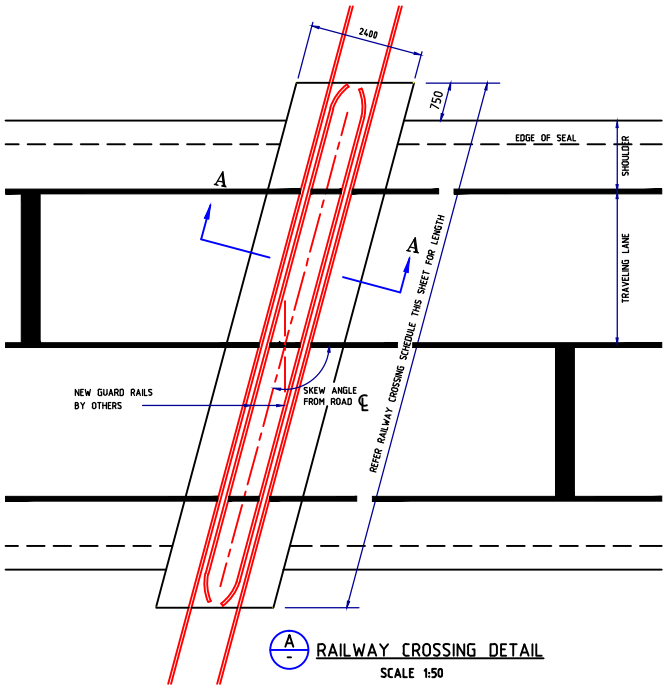
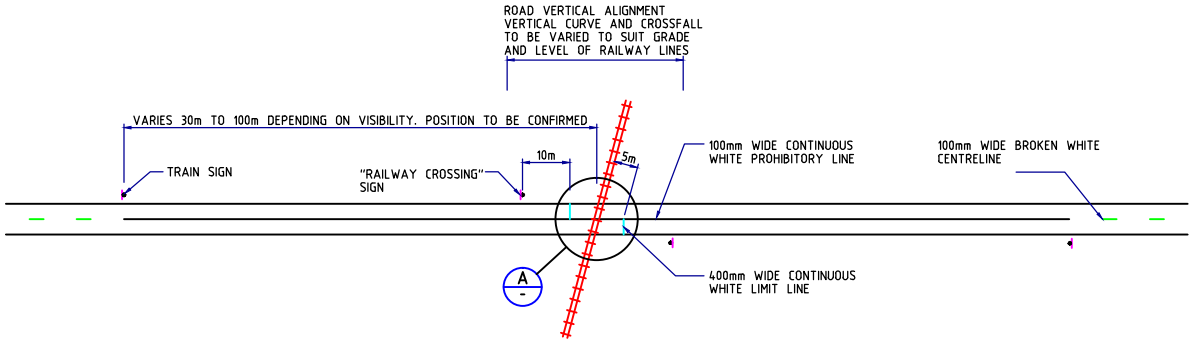
CLIMBING LANE

DRAWN	RAHEL LEMMA	SCALE:	DRG. NO.
DESIGNED	MICHAEL S. NYQUIST	AS SHOWN	G – 08
EDITED	S.KIRSTEN	DATE	
APPROVED	B.JEBESSA	19/03/99	
APPROVED			



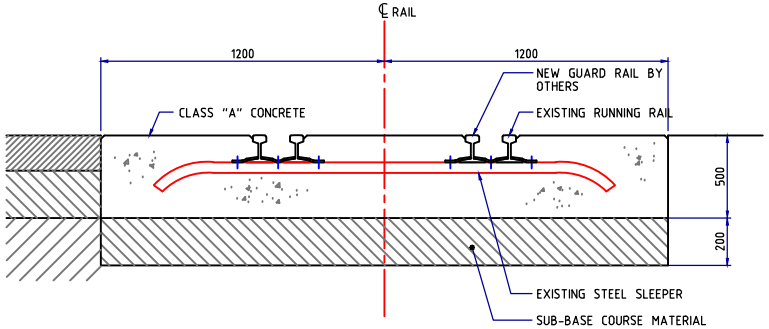
A – RAILWAY CROSSING DETAIL

SCALE 1:50



RAILWAY CROSSING LAYOUT, SIGNAGE AND ROAD MARKING

SCALE 1:500



1 – TYPICAL CROSS SECTION A–A

SCALE 1:10

NOTES:

1. CONTRACT WORKS INCLUDE CONSTRUCTION OF SUB-BASE COURSE AND CONCRETE CROSSING. CONTRACTOR TO LIAISE WITH THE RELEVANT AUTHORITIES TO ARRANGE FOR AND CARRY OUT TRACK RELATED WORK, INCLUDING TEMPORARY SUPPORT, GUARDRAILS AND ADJUSTMENT OF TRACK POSITION
2. ALL CONCRETE TO BE CLASS 20/38. ALL EXPOSED CONCRETE CORNERS AND EDGES TO BE FORMED WITH 15mm CHAMFER

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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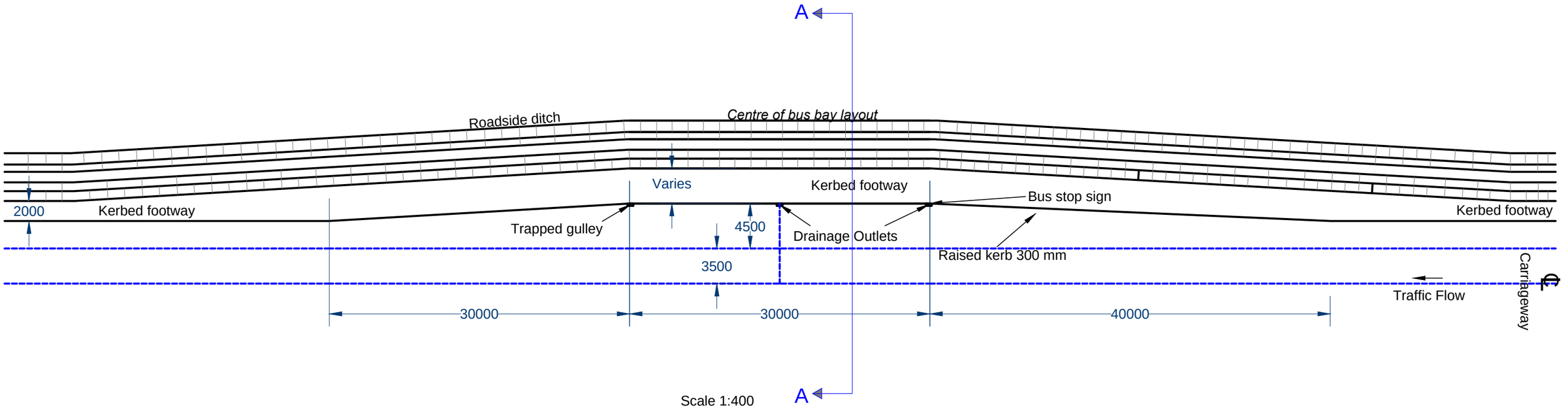
RAILWAY CROSSING

DRAWN	RAHEL LEMMA	SCALE:	DRG. NO.
DESIGNED	MICHAEL S. NYQUIST	AS SHOWN	G – 09
EDITED	S.KIRSTEN	DATE	
APPROVED	B.JEBESSA	12/03/99	
APPROVED			



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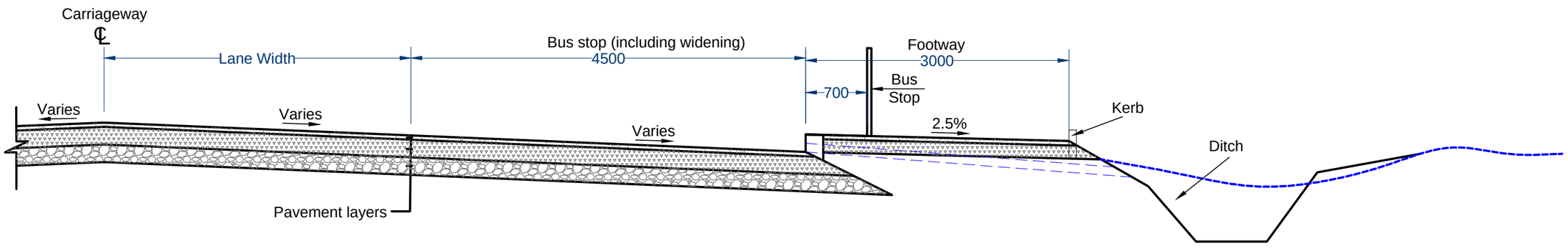

Scale 1:50

Note:
1. All dimensions in mm.
2. Footway width can be altered to suit the site.

TYPICAL CROSS-SECTION THROUGH URBAN BUS BAY (SECTION A-A)

Scale 1:50 (A3)

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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A					

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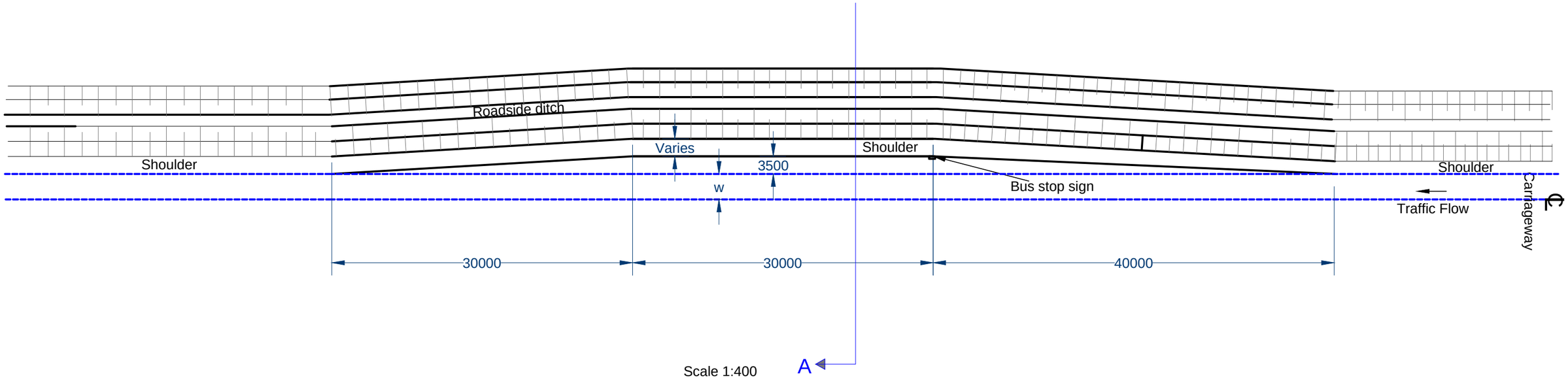
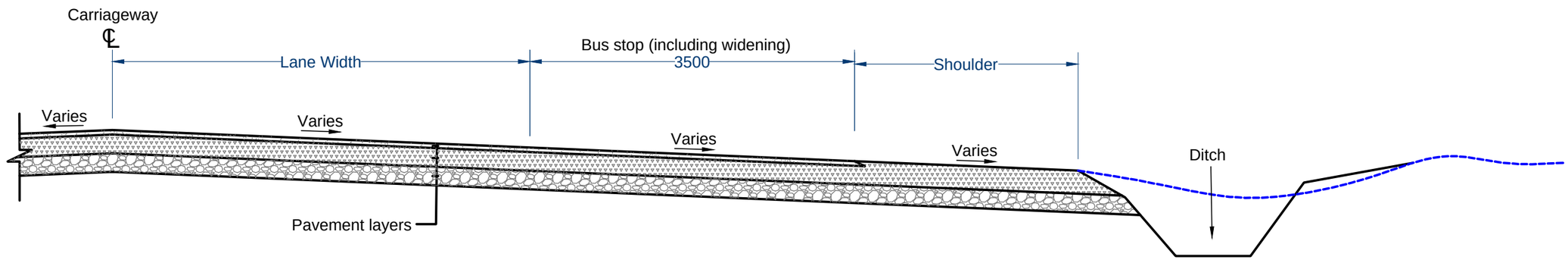
TYPICAL DETAILS OF URBAN BUS BAY

DRAWN	SCALE:As shown (at A3)	DRAWING NUMBER
DESIGNED		G-10A
CHECKED		
APPROVED B. JEBESSA	DATE: December 2011	
EDITED S. KIRSTEN		



Scale 1:400



Scale 1:50

Note:
All dimensions in mm.

TYPICAL CROSS-SECTION THROUGH URBAN BUS BAY (SECTION A-A)

Scale 1:50 (A3)

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

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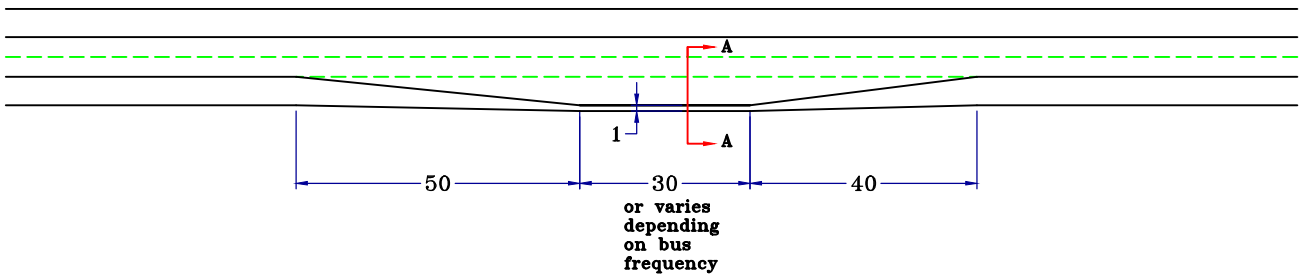
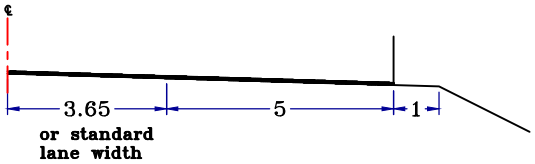
TYPICAL DETAILS OF RURAL BUS BAY

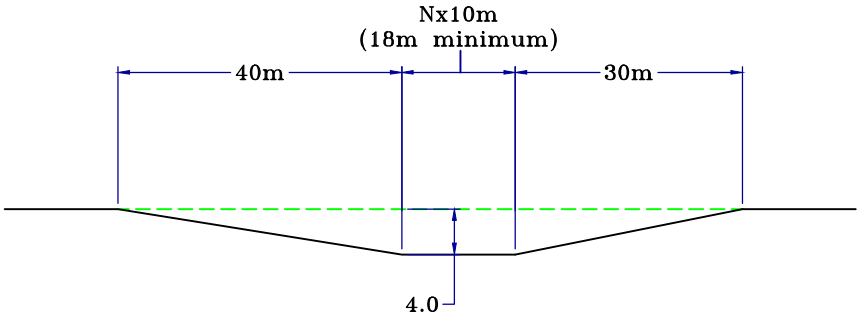
DRAWN	SCALE:As shown (at A3)	DRAWING NUMBER
DESIGNED		G-10B
CHECKED		
APPROVED B. JEBESSA	DATE: December 2011	
EDITED S. KIRSTEN		



BUS LAY – BY



SECTION A – A



PARKING BAY

Length dependent on number of taxis (N)
or other vehicles likely to park at the same time.

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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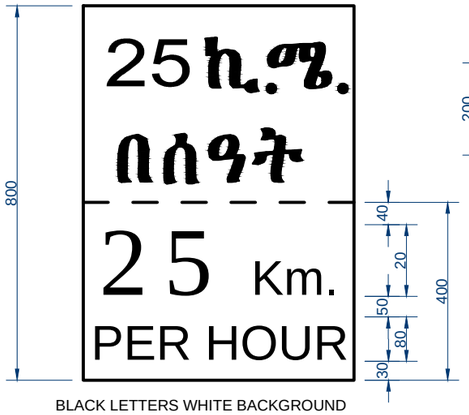
BUS LAY – BY & PARKING BAY

DRAWN	SABELA GETACHEW	SCALE:	DRG. NO.
DESIGNED	MICHAEL S. NYQUIST	AS SHOWN	G – 10
EDITED	S.KIRSTEN	DATE	
APPROVED	B.JEBESSA	09/03/99	
APPROVED			



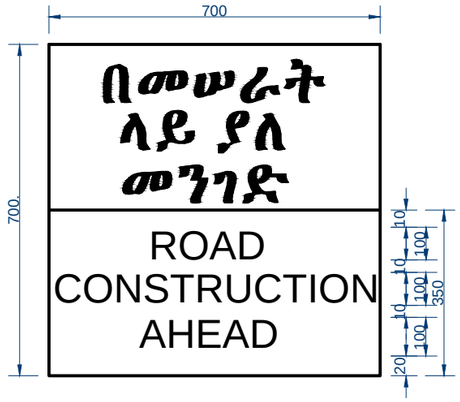
BLACK LETTERS WHITE BACKGROUND

R - 4

WHITE ARROWS, BLACK LETTERS AND BACKGROUND

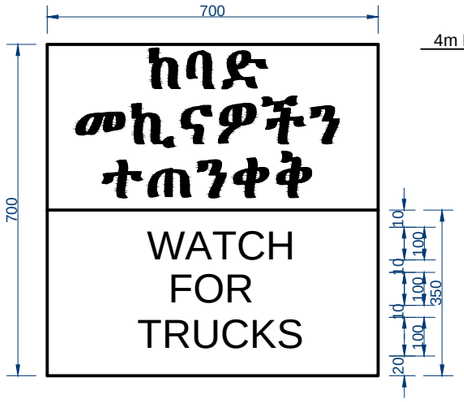
M - 20

(M - 21 POINTING RIGHT)



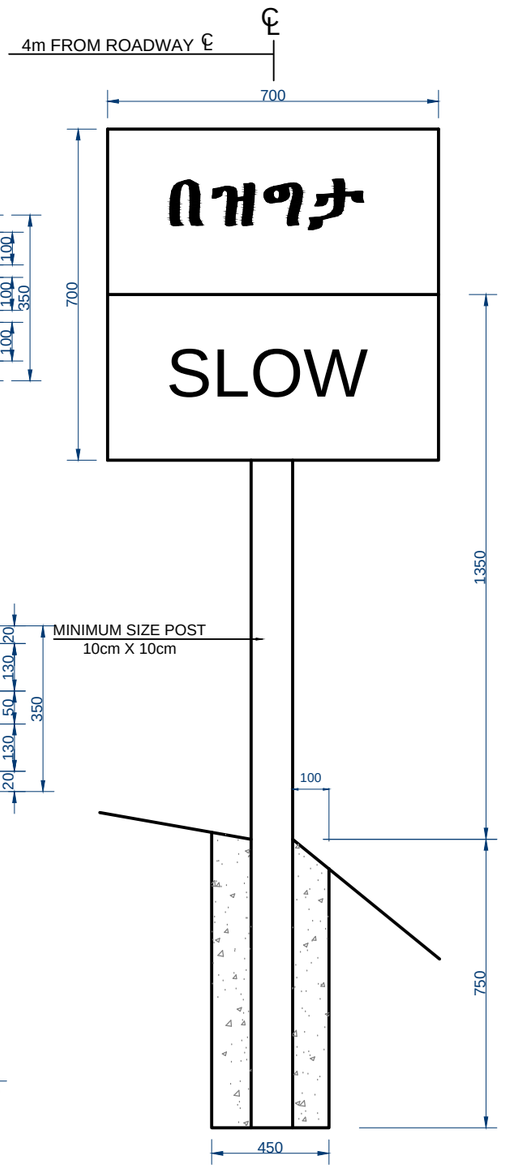
BLACK LETTERS YELLOW BACKGROUND

C - A



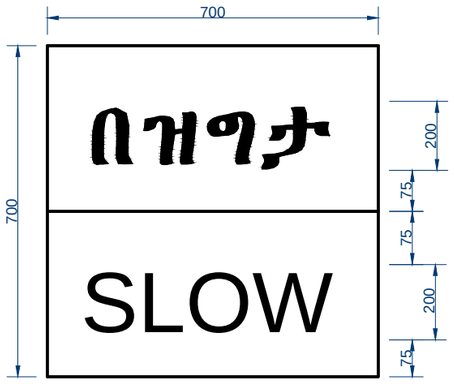
BLACK LETTERS YELLOW BACKGROUND

C - C



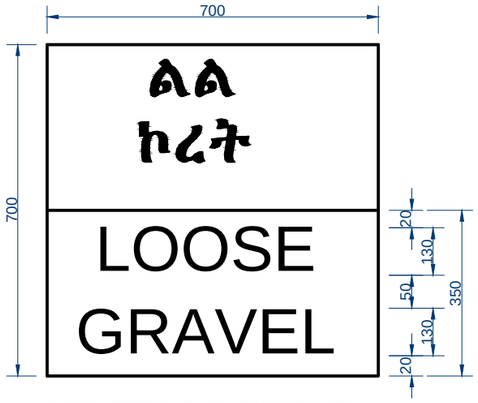
LOCATION OF SIGNS

AS SHOWN OR WITH APPROVAL OF THE ENGINEER, MAY BE PLACED TO ACCOMMODATE CONSTRUCTION CONDITION.



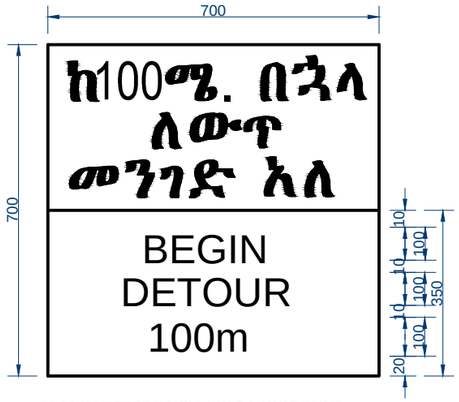
BLACK LETTERS YELLOW BACKGROUND

C - 5



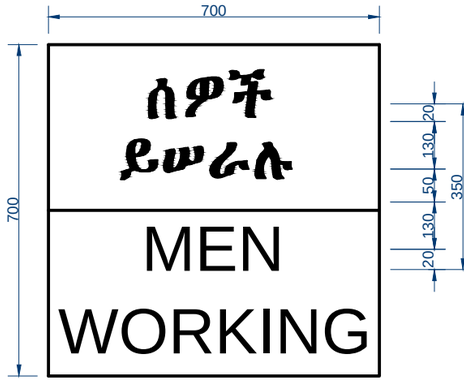
BLACK LETTERS YELLOW BACKGROUND

C - 13



BLACK LETTERS YELLOW BACKGROUND

C - 17



BLACK LETTERS YELLOW BACKGROUND

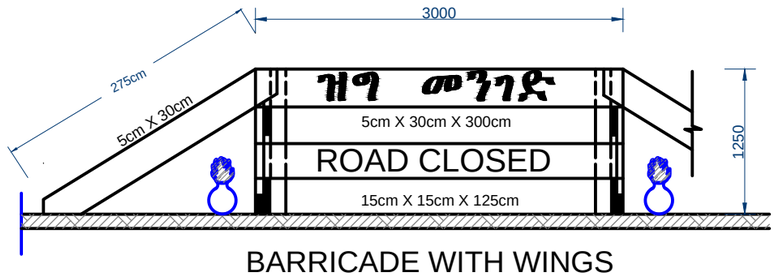
C - 29

ERECTION AND DISPLAY OF SIGNS

THE SIGNS ARE TO BE ERECTED FOR THE PURPOSE OF DIRECTING TRAFFIC OVER A SPECIFIC ROUTE AND SHALL BE SO LOCATED AS TO BE CONSPICUOUSLY VISIBLE DAY AND NIGHT. THEY SHALL BE SET FACING AND ON THE SIDE OF THE APPROACHING TRAFFIC. SIGNS SHALL BE FASTENED WITH 2.2cm CARRIAGE BOLTS TO SUBSTANTIAL POSTS WHERE THEY ARE NECESSARY FOR AN EXTENDED PERIOD. PORTABLE SUPPORTS SUCH AS TRIPODS, ARE PERMITTED FOR SHORT PERIODS, PROVIDED THE CONSTRUCTION IS SUCH THAT WIND OR OTHER AGENTS CAN NOT REALLY UPSET THE SIGN.

USE :- SIGN C - A SHALL BE ERECTED 150m FROM EACH END OF CONSTRUCTION OPERATIONS AND SHALL BE PRECEDED 100m BY A C - 5 SLOW SIGN. SIGN C - C IS TO BE PLACED AT EACH END OF SECTIONS WHERE THE MENTIONED VEHICLES ARE BEING OPERATED AND SHALL BE REPEATED EVERY ONE Km WHERE OPERATION EXTENDS FOR MORE THAN ONE Km. SIGN C - 5 SHALL BE USED SEPARATELY OR IN CONJUNCTION WITH OTHER SIGNS (C - 5 SLOW SIGN TO PRECEDE BY AT LEAST 50m) WHEREVER THE CONDITION OF THE ROAD REQUIRES A REDUCTION OF SPEED. SIGN M - 20 AND M - 21 SHALL BE ERECTED AT THE BEGINNING OF DETOUR. SELECTION AND PLACEMENT OF SIGNS MAY BE SUBJECT TO THE APPROVAL OF THE ENGINEER. SIGNS MAY BE MADE OF WOOD OR METAL. WOOD SIGNS SHALL BE MADE OF 1.5cm PLYWOOD MANUFACTURED WITH SPECIAL WATERPROOF GLUE. METAL SIGNS SHALL BE MADE OF 2mm SHEET METAL .

THE SIGNS TO BE USED AND METHOD OF PLACEMENT SHALL BE AS SHOWN INSOFAR AS THEY APPLY. WHERE IN THE OPINION OF THE ENGINEER, OTHER SIGNS ARE NECESSARY THEY SHALL CONFIRM IN DESIGN TO THOSE HEREON SHOWN AND SHALL BE PLACED AS DIRECTED BY THE ENGINEER.



BARRICADE WITH WINGS

BARRICADE SHALL HAVE, BLACK LETTERS ON YELLOW BACKGROUND. BARRICADE SHALL COMPLETELY BLOCK THE ROAD AND SHALL BE ILLUMINATED AT NIGHT WITH AT LEAST 5 FLARE BOMBS OR RED LIGHTS.

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

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THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA

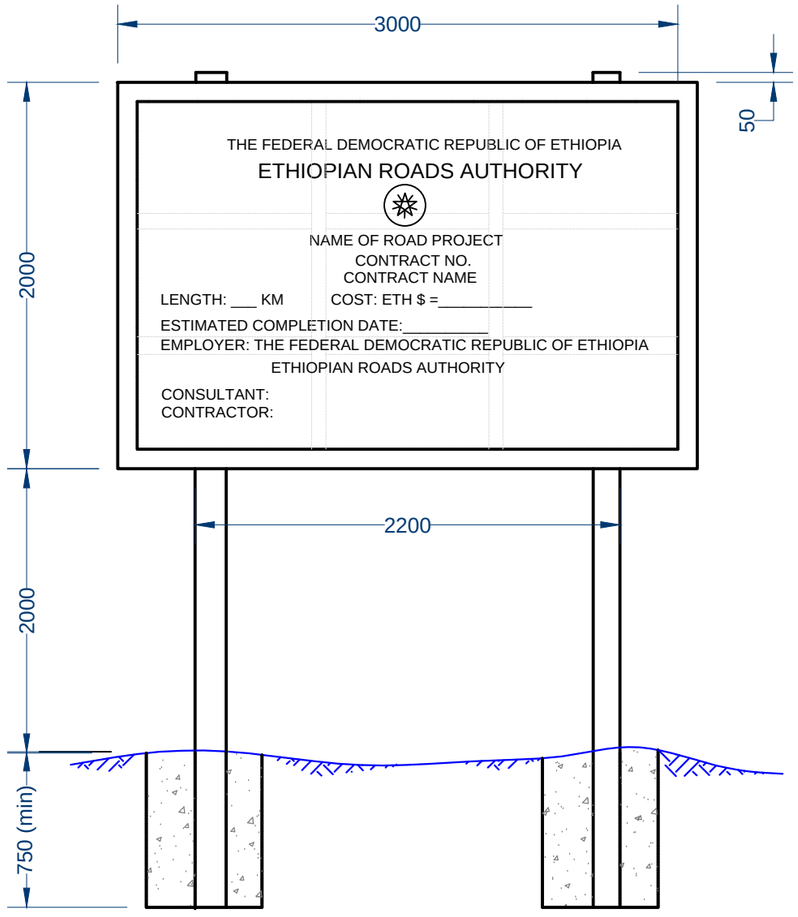
ETHIOPIAN ROADS AUTHORITY

Post Office Box 1770 Addis Ababa Ethiopia
Cable Address Highways Addis Ababa
Telex 21180 Tel.No. 51-71-70/79

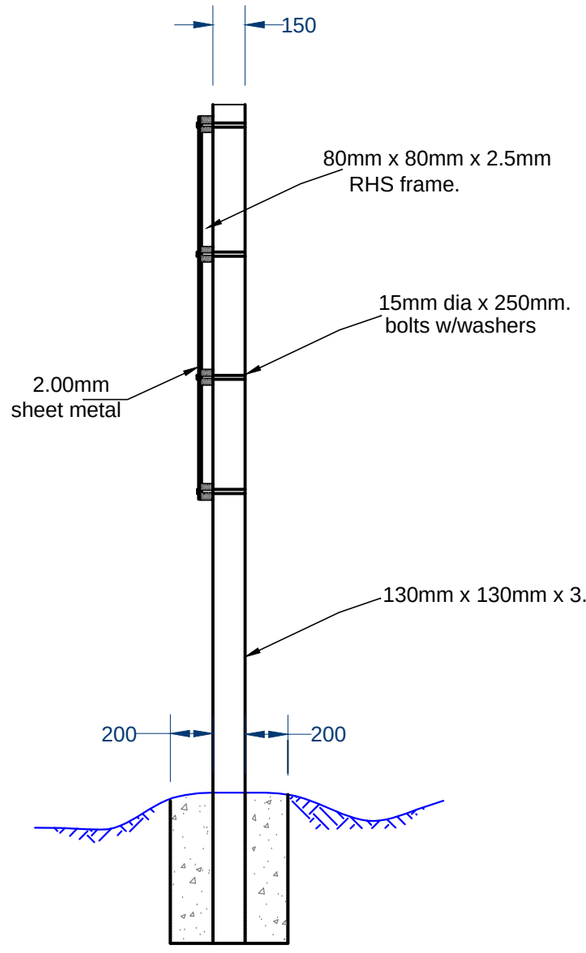
CONSTRUCTION SIGNS

DRAWN	SCALE: NTS	DRAWING NUMBER
DESIGNED		G-IIA
CHECKED		
APPROVED B. JEBESSA	DATE: December 2011	
EDITED S. KIRSTEN		

REFLECTIVE PROJECT SIGN



PROJECT SIGN



NOTE:- 1. All dimensions are in millimetre.
2. Black letters white background.
3. Signs shall be of 2mm sheet metal with frame and shall be erected at each end of project.

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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B					
A					

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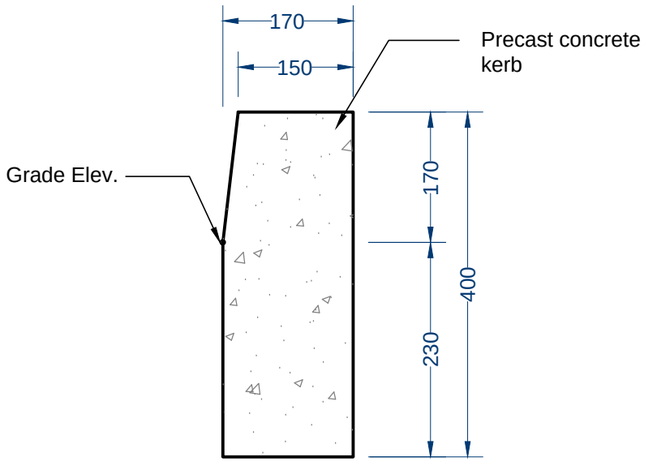
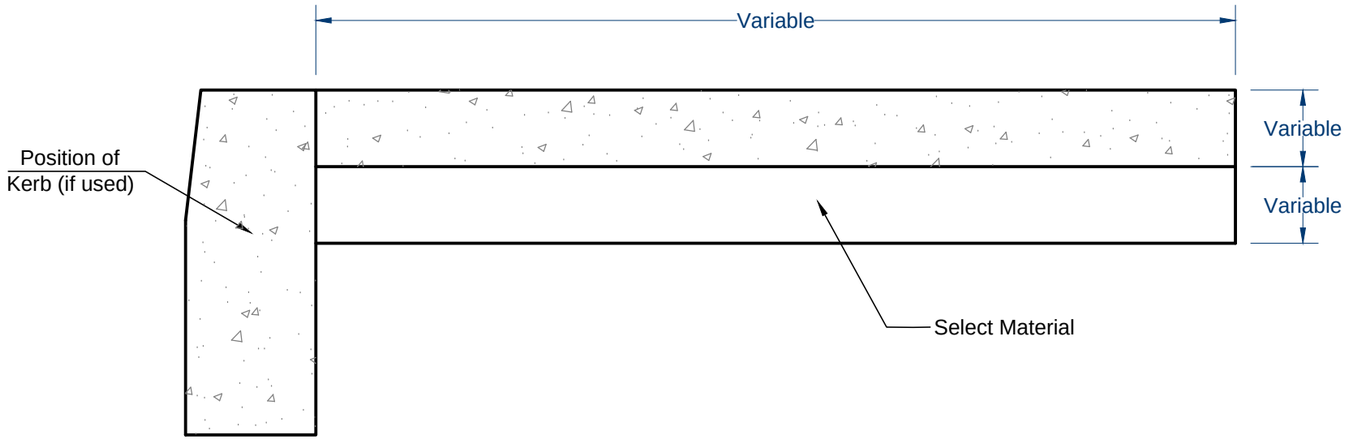
Telex 21180 Tel.No. 51-71-70/79

REFLECTIVE PROJECT SIGN

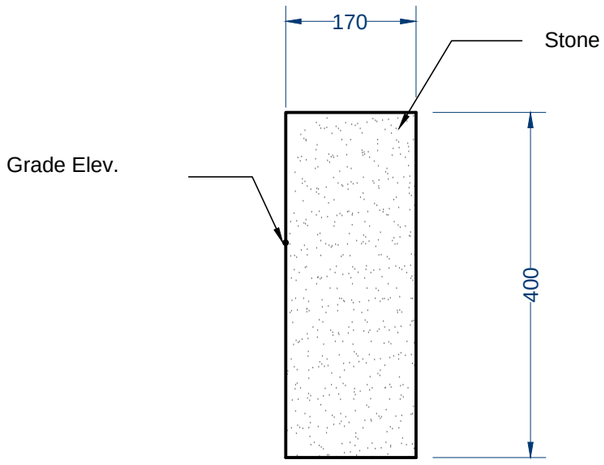
DRAWN	SCALE: NTS	DRAWING NUMBER
DESIGNED		G-IIB
CHECKED		
APPROVED B. JEBESSA	DATE: December 2011	
EDITED S. KIRSTEN		



KERB DETAIL



SIDEWALK DETAIL



STONE KERBING DETAIL

NOTE: Use Concrete Class 20/20
All Dimensions in millimeters.

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
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A					

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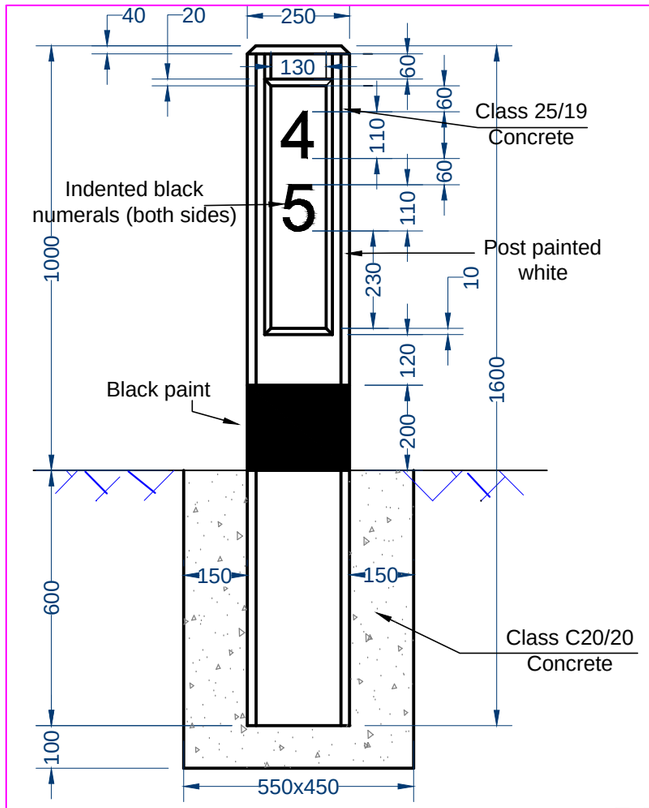
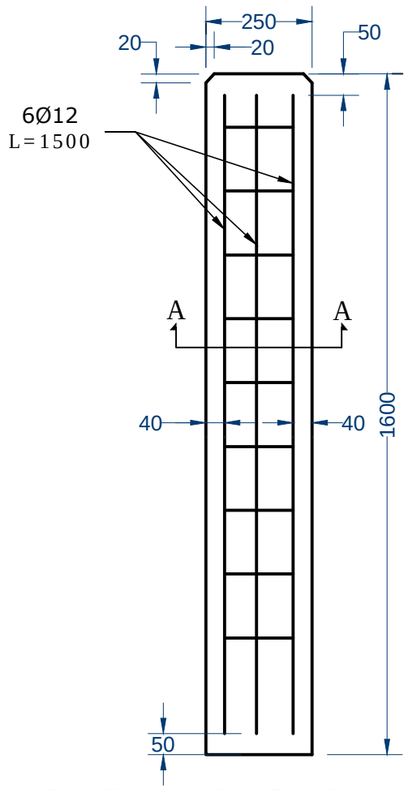
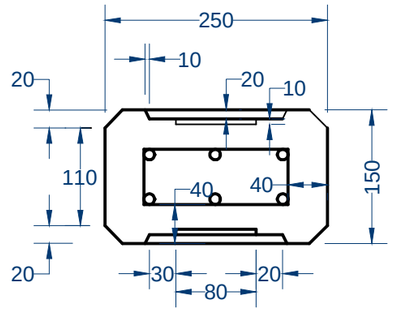
KERB AND SIDEWALK

DRAWN	SCALE: NTS	DRAWING NUMBER
DESIGNED		G-IIc
CHECKED		
APPROVED B. JEBESSA	DATE: December 2011	
EDITED S. KIRSTEN		

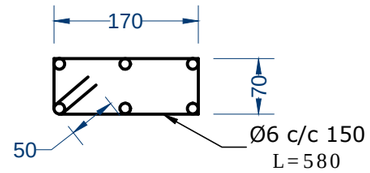


R. CONCRETE KM POST





Section A-A



Stirrup Detail

PRE-CAST R.C. GUIDE POST REINFORCEMENT DETAIL

The Position of Kilometer Posts

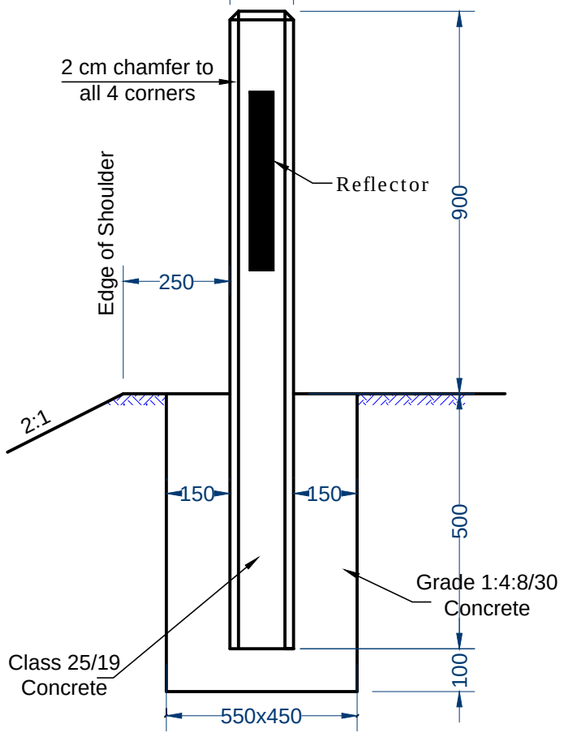
1. Posts to be located as directed by the Engineer
2. The post shall be dug into ground by a method approved by the Engineer.
3. KM post shall be placed at every 1km, alternatively on LHS and RHS as directed by the Engineer.
4. KM post to be a precast concrete class 25/19 with F2 class finish reinforced with 6Ø12 bars longitudinally.
5. All dimensions are in millimeters.
6. The post shall be chamfered by 20mmX20mm to all corners.
7. The letters are painted with blacks.

The Position of Guide Posts

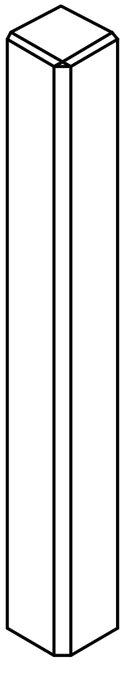
1. On all fill approaches to bridges, guide posts shall be placed 20m apart regardless of fill height (Max 5 posts on each side or max 20 posts for one bridge)
2. Guide posts shall be placed along the alignment according to the table below.
3. On tangent where fill height is over 3m, posts shall be placed 25m apart.
4. No need to place guide post if guardrail is is to be installed.
5. Guide posts to be precast concrete class 25/19 with class F2 surface finish reinforced with 4Ø12 bars longitudinally.
6. The post shall be chamfered by 20mmX20mm to all corners.
7. The post to be backfilled with suitable material compacted to 95% MDD.
8. The post above ground level will be painted with white or as may be directed by the engineer.

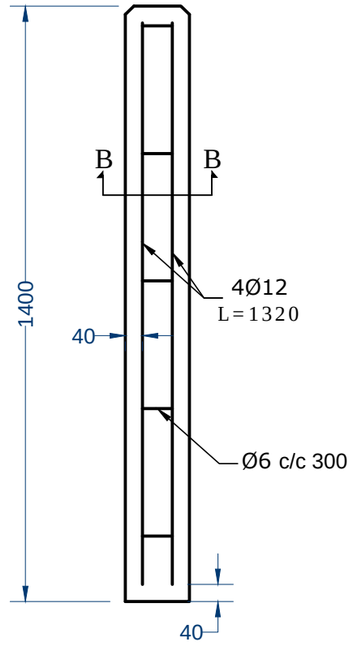
Spacing of guide posts at curves

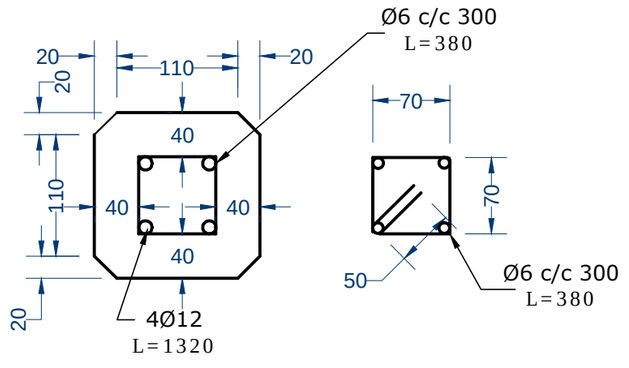
Curve Radius (m)	Guide Post Spacing (m)
500	35
200	20
100	12
50	8
30	5



R.C. GUIDE POST







Section B-B

Stirrup Detail

PRE-CAST R.C. GUIDE POST REINFORCEMENT DETAIL

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

REVISIONS

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KILOMETER AND GUIDE POST DETAILS

DRAWN	SCALE: NTS	DRAWING NUMBER
DESIGNED		G-IID
CHECKED		
APPROVED B. JEBESSA	DATE: December 2011	
EDITED S. KIRSTEN		

GENERAL NOTES

Highway signing is for the controlling, safe guarding and expediting traffic.
The contractor shall place the signs as shown on the plans, and such others as directed by the Engineer near the end of his contract right after clean up operation, before semi-final inspection.
The plans have not endeavored to show the locations of Pedestrian and Animal crossings, a quantity is shown to be placed as directed by the Engineer.
The sign-plate shall be to the dimensions shown on details, of Aluminum Alloy; thickness of 2.0mm; alloy 6061-T6 according to A.S.T.M. Specification No. B209M, with corners rounded on 4 cm. radius.
Reflective sheeting background is to be white, wide angle flat top heat/solvent activated adhesive (3 M Co. No. 2270 series).
Transparent Red Paint for borders (3 M Co. No. 700 series)
Opaque Black Paint on lettering and symbols (3 M Co. No. 700 series).
Stop sign is the only one to have background of Transparent red, Lettering is to be White reflective sheeting and Border is Silver reflective sheeting.
All Warning Signs shall be conspicuously located, in advance of the point where the traffic regulation begins, Numbers 1 2 3 4 5 6 7 8 shall be 100 to 150 meters in advance of the above point, Numbers 9 10 11 12 shall be placed 75 to 100 meter in advance, Number 13 is 10 meters as shown on detail, Number 3-4 for curves speeds less than 80 K.P.H.
Number 5 for Reverse curves and Winding roadway shall be repeated every Km.where the winding road is continuous or separated by 500 meter tangents.
Number 9 steep grade sign on grades that exceed
7 % for more than 1000 meters.
8 % for more than 400 meters.
9 % and over for any length of grades.
Town name signs #14 are variable length depending on size of name,

All signs except the stop sign are to be placed as pairs one at either end of the warning.
All dimensions should be in SI units.

① Right Curve — Placed on Horizontal Curves that are between 7 ° to 15 °

② Left Curve

③ Right Curve — Placed on Horizontal Curves that exceed 15 °

④ Left Curve

⑤ Both Right & Left Reverse — Curves & Winding Roadway of 2 curves or more

⑥ Cross Road

⑦ Road Intersection Right

⑧ Road Intersection Left

⑨ Grades over 7 %

⑩ Pedestrian Crossing

⑪ Schools & Playground

⑫ Road Narrowing

⑬ Animal Crossing

⑭ Towns
To be placed at Edge of Towns

⑮ 10 meters Back of Intersections on side roads

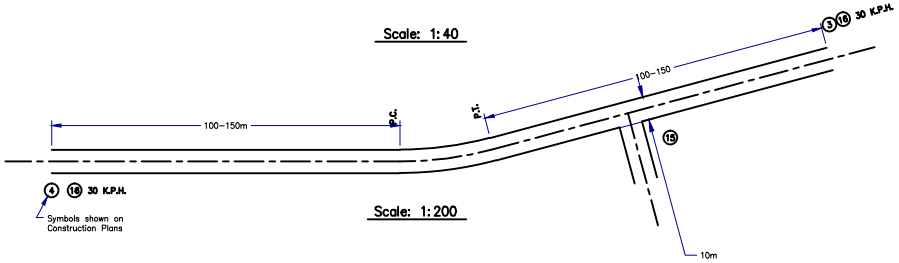
⑯ Speed Limit

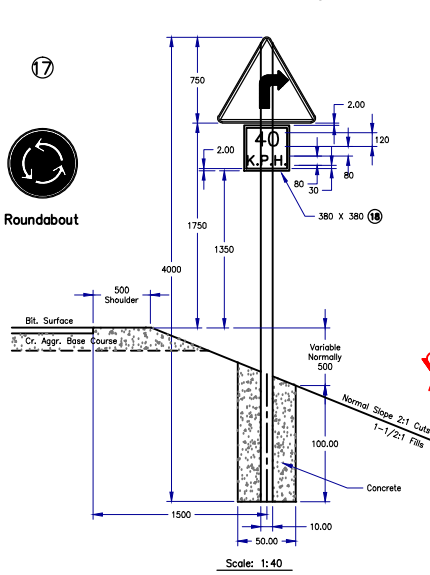
⑰ Roundabout

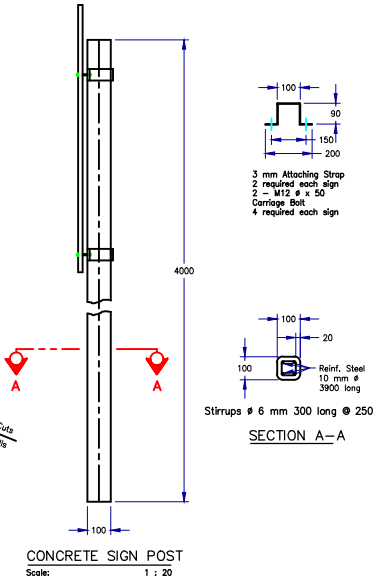
⑲ Obligatory Direction

⑳ Mens Working

㉑ Zebra Crossing







CONCRETE SIGN POST
Scale: 1 : 20

SECTION A-A

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

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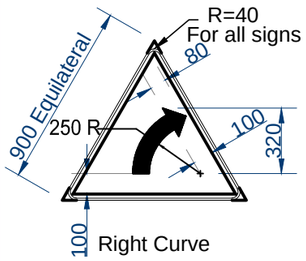
ETHIOPIAN ROADS AUTHORITY
Post Office Box 1770 Addis Ababa Ethiopia
Cable Address Highways Addis Ababa
Telex 21180 Tel.No. 51-71-70/79

TRAFFIC SIGNS

DRAWN	RAHEL LEMMA	SCALE:	DRG. NO.
DESIGNED	JOHN ALLEN	AS SHOWN	G - 11
CHECKED	MICHAEL S. NYQUIST	DATE	
EDITED	S.JORSTEN	09/03/99	
APPROVED	B.JEBESSA		

1



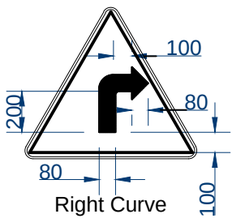
Right Curve

Placed on Horizontal Curves between 7 ° to 15 °

2

Left Curve

3



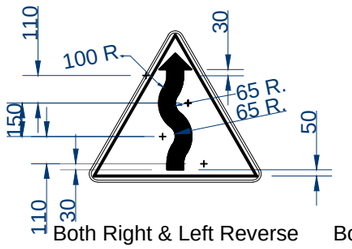
Right Curve

4

Left Curve

Placed on Horizontal Curves that exceed 15 °

5



Both Right & Left Reverse

6

Both Right & Left Reverse

Curves & Winding Roadway of 2 curves or more

7

Left then Right

8

Right then Left

9

Right then Left

10

Hairpin Curve Right

11

Hairpin Curve Left

12

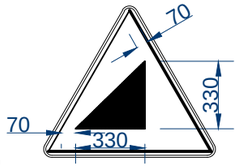
13

270 Degree Loop

14

Round About Ahead

15

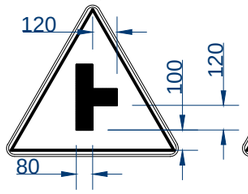


Steep Ascent Ahead

16

Steep Decent Ahead

17



Road Intersection Right

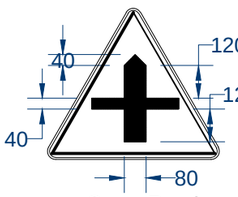
18

Road Intersection Left

19

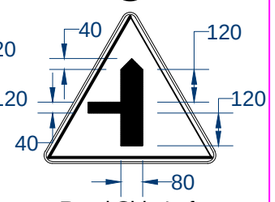
Y Symbol

20



Cross Road

21

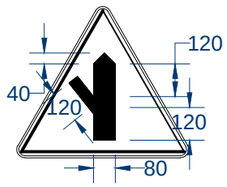


Road Side Left

22

Road Side Right

23

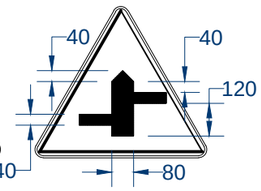


Y Intersection

24

Y Intersection

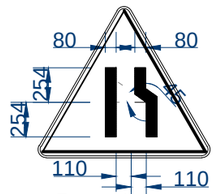
25



Staggered Intersection

26

27



Road Narrows
to the Left

28

Road Narrows
to the Right

29

Both Sides
Ends

30

Dual Carriageway
Ends

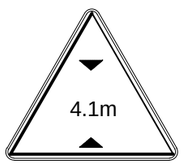
31

Dual Carriageway

32

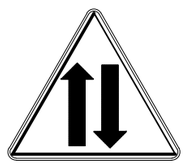
Dual Carriageway
Ahead

33



Height Limit

34



Two Way Traffic

35

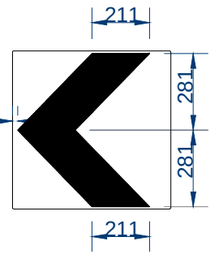
Falling Rocks

36

Falling Rocks

37

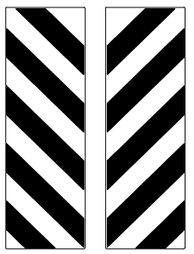
Long Chevron



38

T Intersection Chevron

39

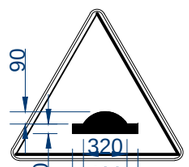


Edge Hazard Plate

40

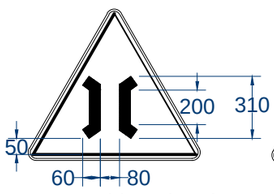
Road Way
Hazard Plate

41



Hump Ahead

42



Narrow Bridge Ahead

43

Schools & Playground

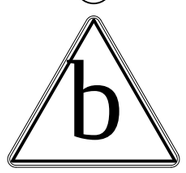
44

Pedestrian Crossing

45

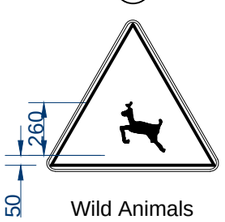
Men at Work

46



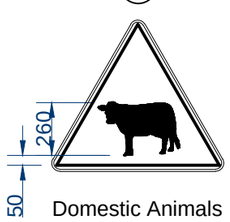
Bicycles In the Road

47



Wild Animals

48



Domestic Animals

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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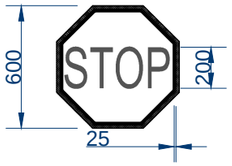
TRAFFIC SIGNS
WARNING SIGNS

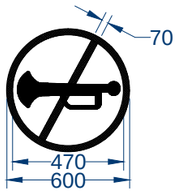
DRAWN	SCALE: NTS	DRAWING NUMBER
DESIGNED		G-12A
CHECKED		
APPROVED B. JEBESSA	DATE: December 2011	
EDITED S. KIRSTEN		

RS1



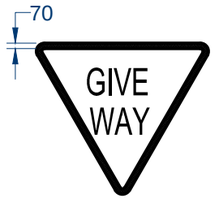
Stop Sign

RS2



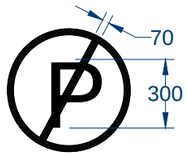
Horn Prohibited

RS3



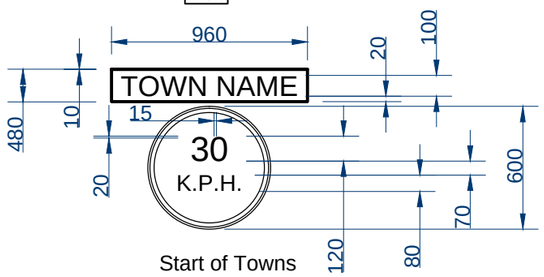
Give Way

RS4



No Parking

RS5



Start of Towns

RS6

End of Towns

RS7

Restriction End

RS8

No Overtake

RS9

Speed Limit

RS10

Obligatory Direction

RS11

Compulsory Ahead Only

RS12

Load Limit

RS13

No Pedestrian Crossing

RS14

Roundabout

RS15

U Turn Prohibited

RS16

RS17

No Right Turn

RS18

No Left Turn

RS19

No Trucks

RS20

No Bicycles

RS21

No Stopping
or Standing

RS22

Compulsory
Keep Left

RS23

Width Limit

RS24

Height Limit

RS25

Axle Load Limit

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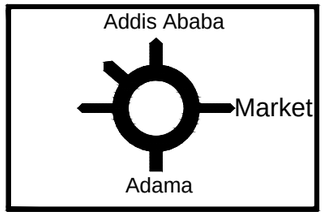
TRAFFIC SIGNS
REGULATORY SIGNS

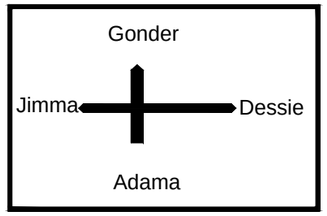
DRAWN	SCALE: NTS	DRAWING NUMBER
DESIGNED		G-12B
CHECKED		
APPROVED B. JEBESSA	DATE: December 2011	
EDITED S. KIRSTEN		

GS01



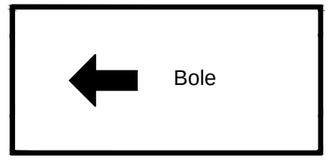
MAP-TYPE ADVANCE DIRECTION SIGN-ROUNDABOUT, PRIMARY ROADS

GS02



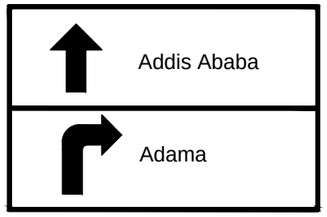
MAP-TYPE ADVANCE DIRECTION SIGN-ROUNDABOUT, PRIMARY ROADS

GS03



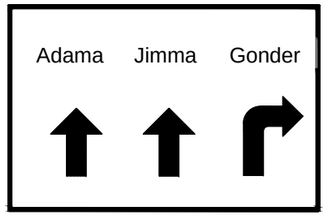
DIRECTION SIGN

GS04



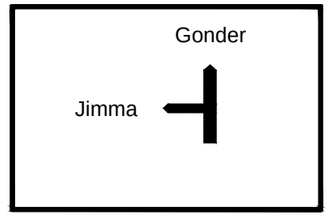
STAKE-TYPE ADVANCE DIRECTION SIGN-PRIMARY ROADS

GS05



LANE PRE-SELECTION SIGN-PRIMARY ROADS

GS06



MAP-TYPE ADVANCE DIRECTION SIGN-INTERSECTION CROSS ROAD PRIMARY ROADS

NOTE:

1. Concrete for foundation should be class 20/20.
2. Sign plates shall conform to ASTM A,366 for steel sheets or ASTM B, 209, 6061-T6 for aluminium alloy.
3. Sign posts shall consist of steel pipes conforming to the requirement of ASTM A 52 grade B to be galvanized in accordance with ASTM A 123.
4. Reflective sheeting shall comply with ASTM D 4956.
6. The location of the guide sign will be decided by the Engineer.

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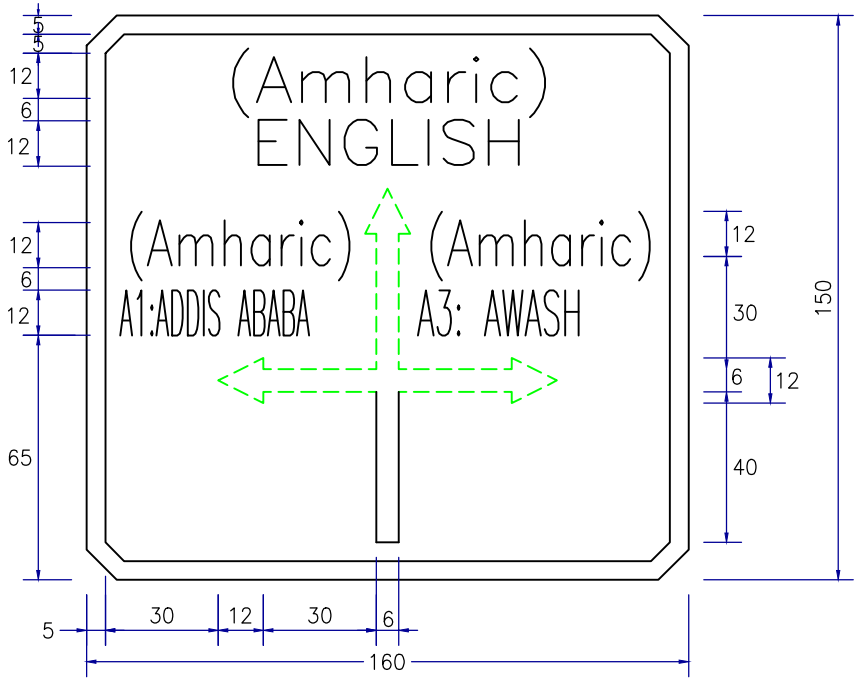
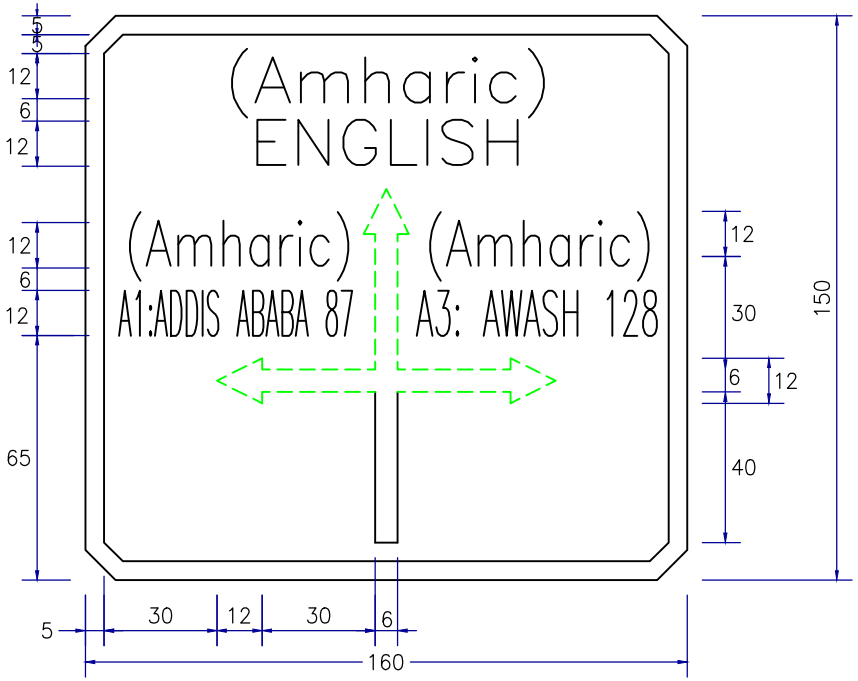
GUIDE SIGNS

DRAWN	SCALE: NTS	DRAWING NUMBER
DESIGNED		G-12c
CHECKED		
APPROVED B. JEBESSA	DATE: December 2011	
EDITED S. KIRSTEN		



MAIN JUNCTION DESTINATION SIGN



OTHER DESTINATION SIGN

All dimensions are in mm

GENERAL NOTES

The contractor shall place the signs as shown on the plans, and such others as directed by the Engineer near the end of his contract after clean up operation, before semi-final inspection.

The sign-plate shall be to the dimensions shown on detail, of Aluminum Alloy; thickness of 2.0mm; alloy 6061-T6 according to A.S.T.M. Specification No. B209M, with corners rounded on 4 cm. radius.

Reflective sheeting background is to be silver, wide angle flat top heat/solvent activated adhesive (3 M Co. No. 2270 series).

Transparent Red Paint for borders (3 M Co. No. 700 series)

Opaque Black Paint on lettering and symbols (3 M Co. No. 700 series).

All dimensions should be in SI units.

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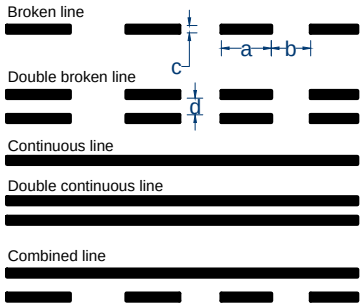
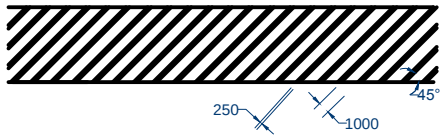
DESTINATION SIGN

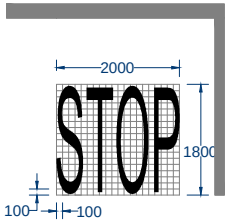
DRAWN	SABELA GETACHEW	SCALE:	DRG. NO.
DESIGNED	MICHAEL S. NYQUIST	AS SHOWN	G – 12
EDITED	S.KIRSTEN	DATE	
APPROVED	B.JEBESSA	09/03/99	
APPROVED			



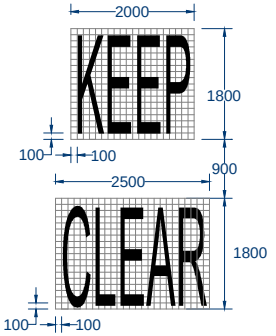
LONGITUDINAL MARKING



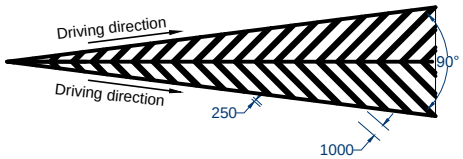
HATCHED MARKINGS (HM)



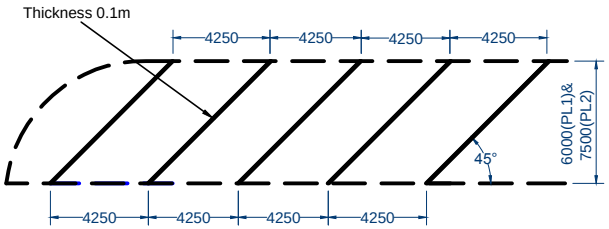
STOP MARKING
WORDED MARKINGS (WHITE)



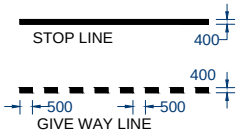
KEEP CLEAR WARNING
WORDED MARKINGS (WHITE)

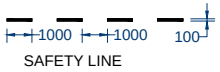


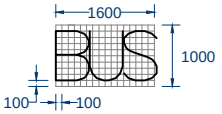
CHEVRON MARKINGS (CM)



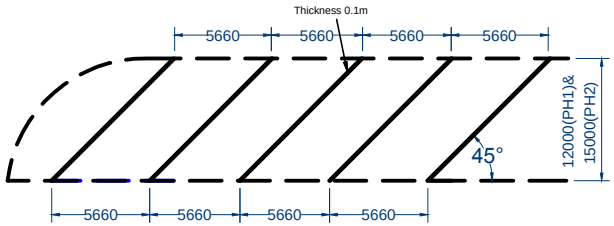
PARKING BAYS FOR LIGHT GOODS VEHICLES
AND CARS (TYPE PL1=6.0m AND PL2=7.5m)



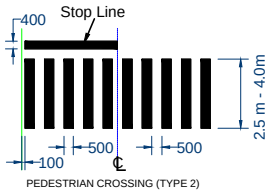




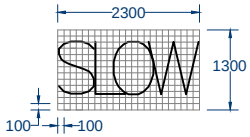
BUS MARKING
WORDED MARKINGS (WHITE)



PARKING BAYS FOR BUSES AND TRUCKS
(TYPE PH1=12.0m AND PH2=15.0m)



PEDESTRIAN CROSSING (TYPE 2)



SLOW MARKING
WORDED MARKINGS (WHITE)

Note:
1. All dimensions in mm unless specified.
2. Dimensions to be instructed by the Engineer.

LINE TYPE REF.	DESCRIPTION	GRAPHICS	CATEGORY							
			A				B			
			a	b	c	d	a	b	c	d
1	Continuous line				0.1				0.1	
2	Double continuous line				0.1	0.1			0.1	0.1
3	Broken line		3.0	9.0	0.1		2.0	6.0	0.1	
4	Broken line		2.0	2.0	0.1		2.0	2.0	0.1	
5	Broken line		1.0	1.0	0.2		1.0	1.0	0.2	
6	Combined line		3.0	9.0	0.1	0.1	2.0	6.0	0.1	0.1
7	Combined line		3.0	9.0	0.1	0.1	2.0	6.0	0.1	0.1
8	Double broken line		3.0	9.0	0.1		2.0	6.0	0.1	

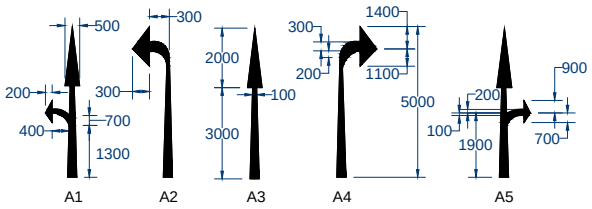
Measure in m

Note: Line Type Ref. suffix; w=white, y=yellow line

a= Length of stroke
b= Length of gap
c= Width of line
d= Distance between lines

Refer to line type category in table 1 and line diagrams

Note:
Categories A and B in table 1 are appropriate
for road sections with design speeds above 60km/hr
and less respectively.



LANE INDICATION ARROWS

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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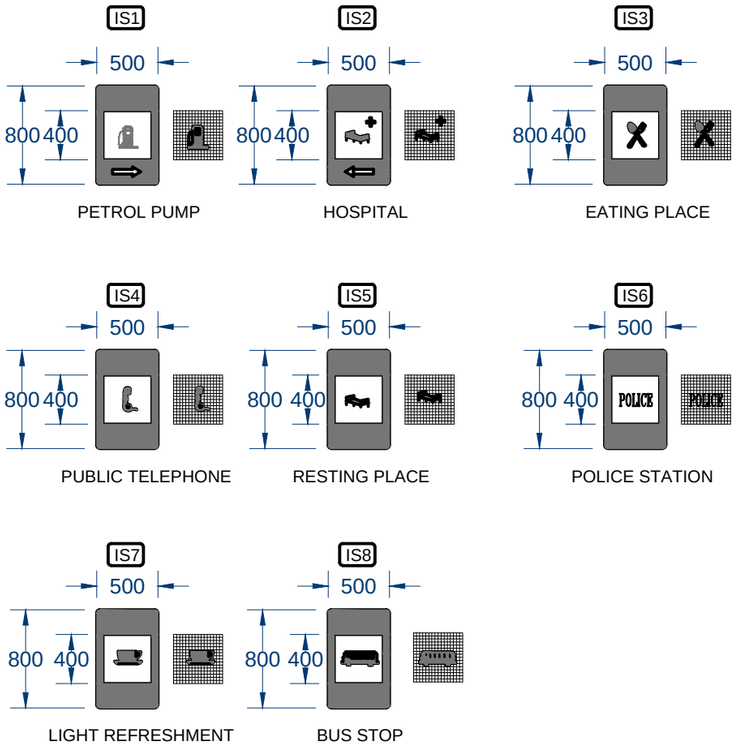
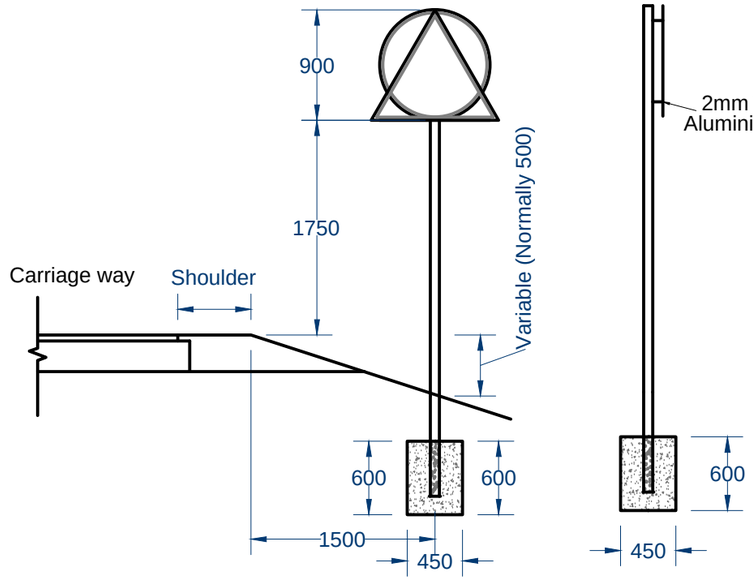
ROAD MARKINGS

DRAWN		SCALE: NTS	DRAWING NUMBER
DESIGNED			G-13
CHECKED		DATE: December 2011	
APPROVED	B. JEBESSA		
EDITED	S. KIRSTEN		

INFORMATION SIGNS



Scale 1:50

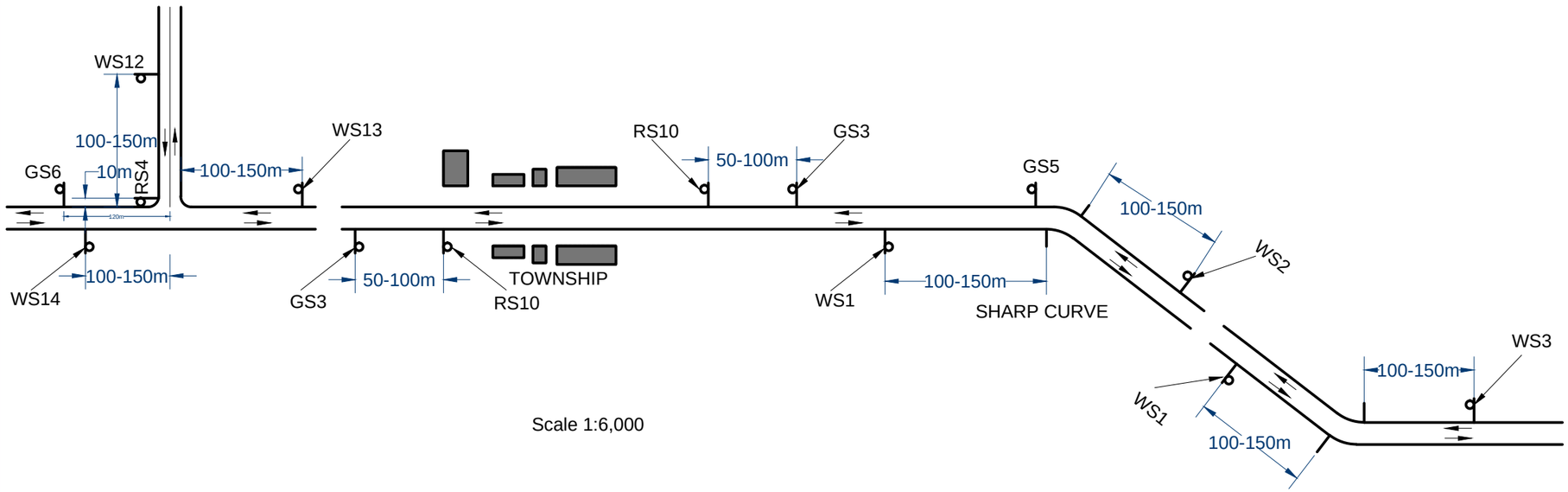


Scale 1:50

NOTE:
1. Post to be painted with alternative black and white strips.
2. Top of post to be capped.

SIGN AREA (sqm)	POST (dia)
0.1 - 0.4	75mm
0.4 - 1.0	90mm
1.0 - 2.0	115mm
> 2.0	Two Posts

STANDARD SIGN INSTALLATION



Scale 1:6,000

LOCATION OF SIGNS

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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B					
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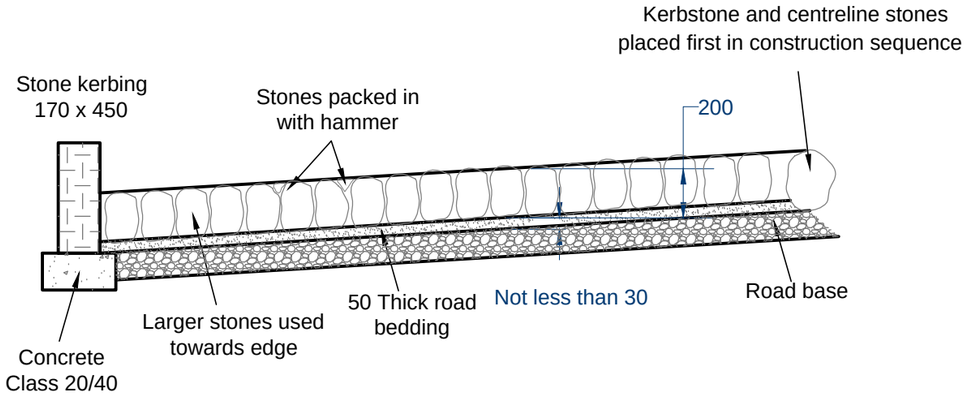
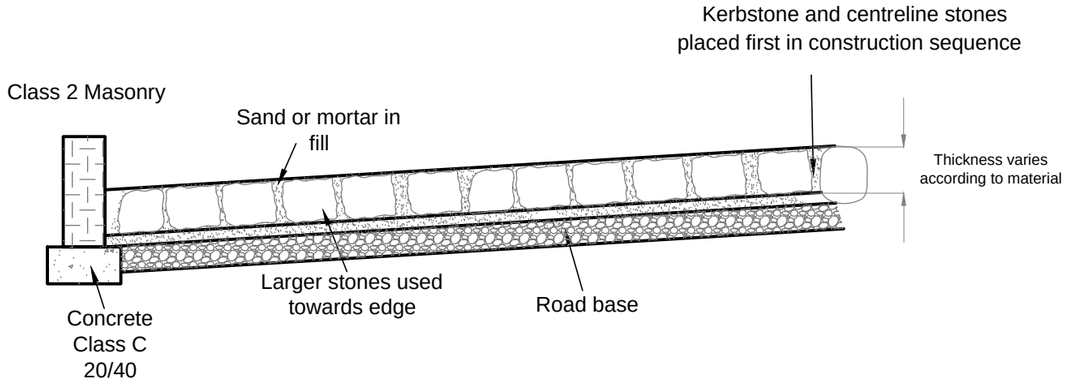
INFORMATION SIGN

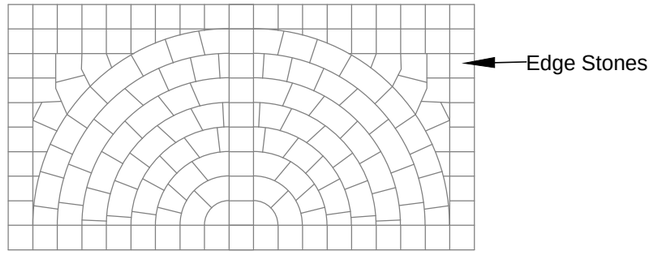
DRAWN		SCALE: As shown (at A3)	DRAWING NUMBER
DESIGNED			G-14
CHECKED		DATE: December 2011	
APPROVED	B. JEBESSA		
EDITED	S. KIRSTEN		

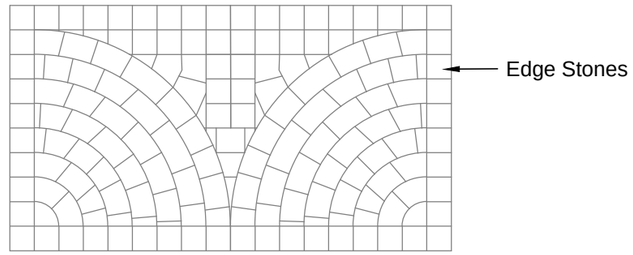


HAND PACKED STONE PAVING
MORTARED HAND PACKED STONE PAVING

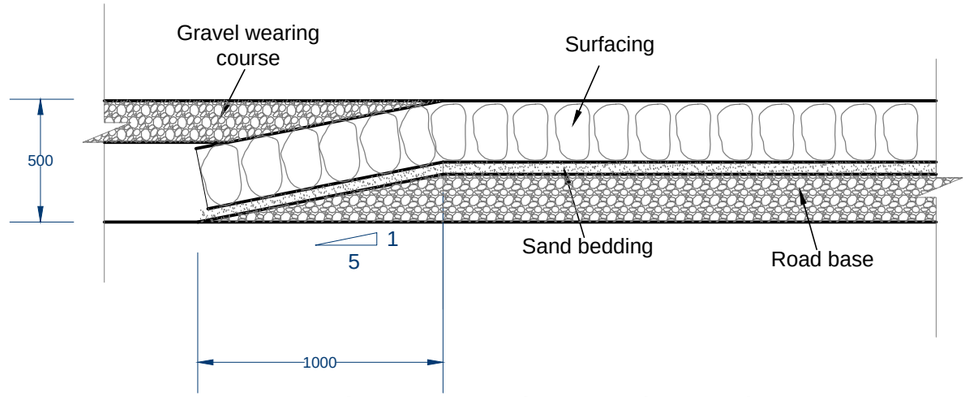


STONE SETS, DRESSED STONE AND
COBBLESTONE PAVING





STONE SETTS AND COBBLESTONE PATTERNS



Transverse Joint to Gravel or Earth Road

NOTES:
(1) All dimensions in mm.

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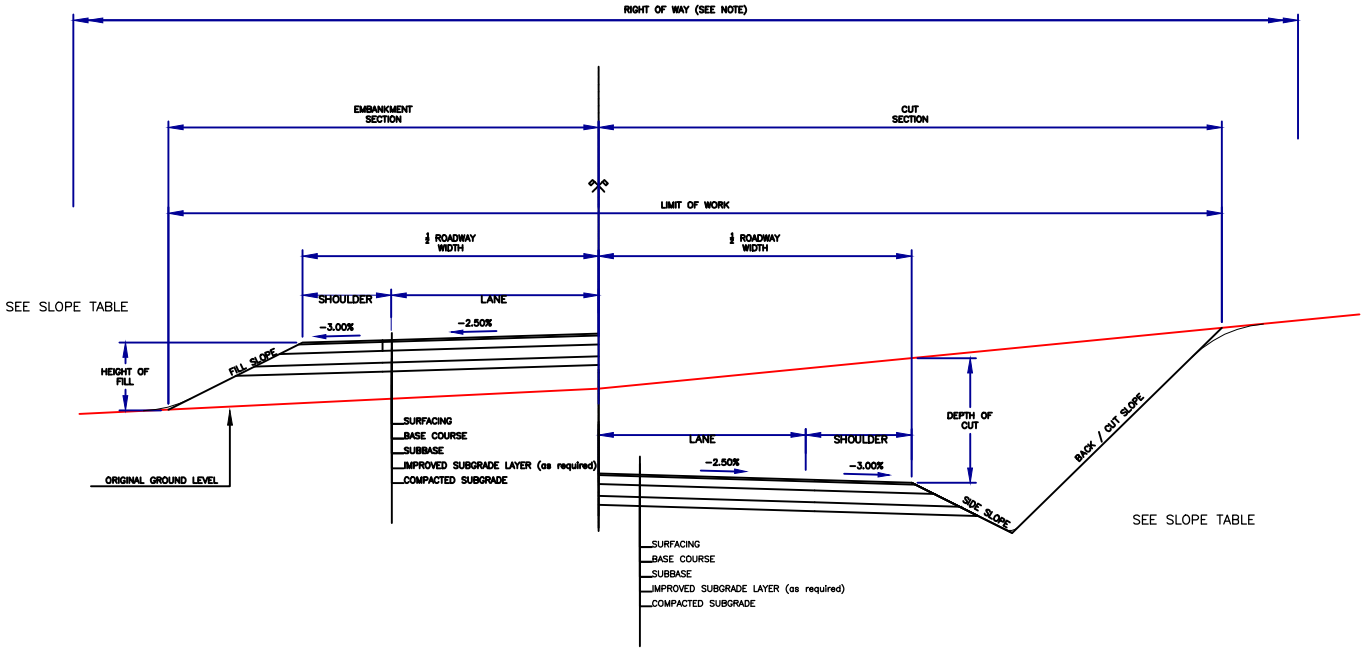
STONE PAVINGS

DRAWN		SCALE: 1:25 (at A3)	DRAWING NUMBER
DESIGNED			G-15
CHECKED		DATE: December 2011	
APPROVED	B. JEBESSA		
EDITED	S. KIRSTEN		

Slope Terms Used In Cut & Fill Sections



NOTES

1. SIDE & BACK SLOPES RATIO TABLE SHALL BE USED ACCORDING TO THE HEIGHT OF FILL AND CUT AND THE MATERIAL TYPE
2. RIGHT OF WAY MAY BE VARIABLE FOR OPEN AND BUILT-UP AREAS. THE DESIGN STANDARD AND EMPLOYER RECOMMENDATION SHALL BE APPLIED.
3. RIGHT OF WAY IN TOWNS / VILLAGES, TO SAVE DEMOLISHING OR MAJORITY OF PROPERTIES ONLY 1.0 METER ADDITIONAL AREA SHALL BE USED FOR UTILITY OUTSIDE THE LIMIT OF WORK.
4. RIGHT OF WAY IN OPEN FIELD SHALL INCLUDE 3.0 METERS WORKING AREA OR AS MAY BE DIRECTED BY THE ENGINEER.

SLOPE RATIO TABLE

MATERIAL TYPE	"Depth of Cut /Ht of Fill (H)" (m)	SIDE SLOPE		BACK / CUT SLOPE
		CUT	FILL	
EARTH / SOIL	0 – 1	2H : 1V	3H : 1V	3H : 1V
	1 – 2	2H : 1V	2H : 1V	2H : 1V
	2– 10	2H : 1V	3H : 2V	3H : 2V
	>10	2H : 1V*	3H : 2V	BENCHED SLOPE
DECOMPOSED ROCK	0 – 1	2H : 1V	3H : 1V	3H : 1V
	1 – 2	2H : 1V	2H : 1V	2H : 1V
	2– 10	2H : 1V	3H : 2V	3H : 2V
	>10	2H : 1V*	3H : 2V	BENCHED SLOPE
WEATHERED ROCK	0 – 2	2H : 1V	3H : 2V	1H : 2V
	> 2	2H : 1V	1H : 1V	1H : 3V
ROCK	0– 2	2H : 1V	5H : 4V	1H : 2V
	>2	2H : 1V*	1H : 1V	1H : 4V
BLACK COTTON SOIL	0– 2	2H : 1V	6H : 1V	3H : 1V
	>2	2H : 1V*	4H : 1V	2H : 1V
COLLUVIAL DEPOSIT	0 – 3	2H : 1V	3H : 1V	1H : 1V
	3 – 6	2H : 1V	2H : 1V	5H : 4V
	6– 10	2H : 1V	3H : 2V	5H : 3V
	>10	2H : 1V*	3H : 2V	BENCHED SLOPE

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CROSS SECTION TERMINOLOGY AND SLOPE RATIO TABLE

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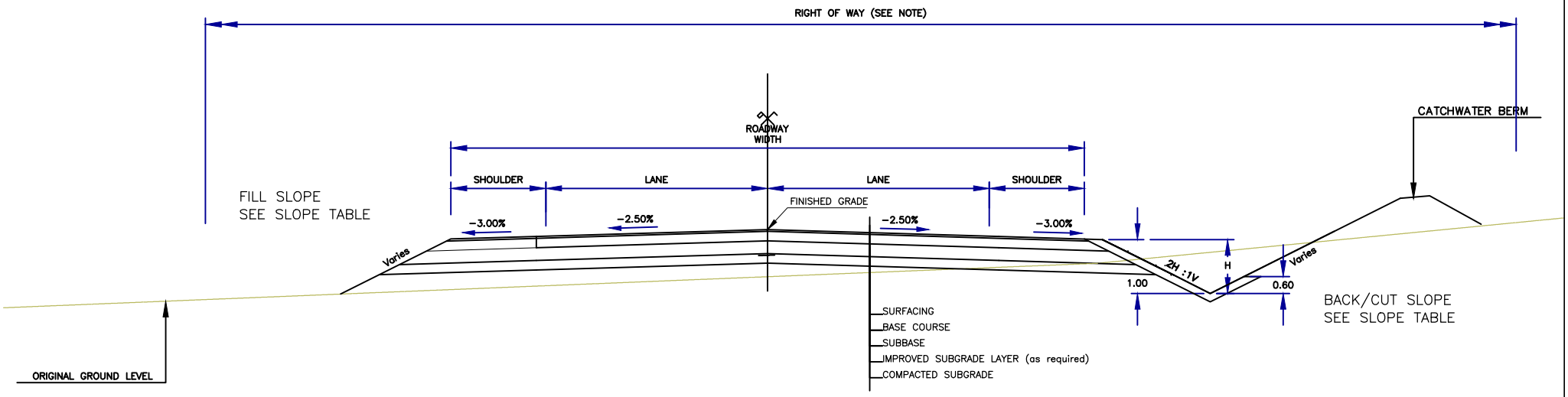
DESIGNED	BJ	AS SHOWN	G – 16a
CHECKED	BJ	DATE	
EDITED	SJURSTEN	15/06/2015	
APPROVED			



Normal Cut and Fill Sections

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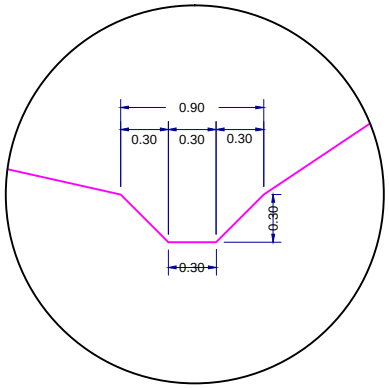
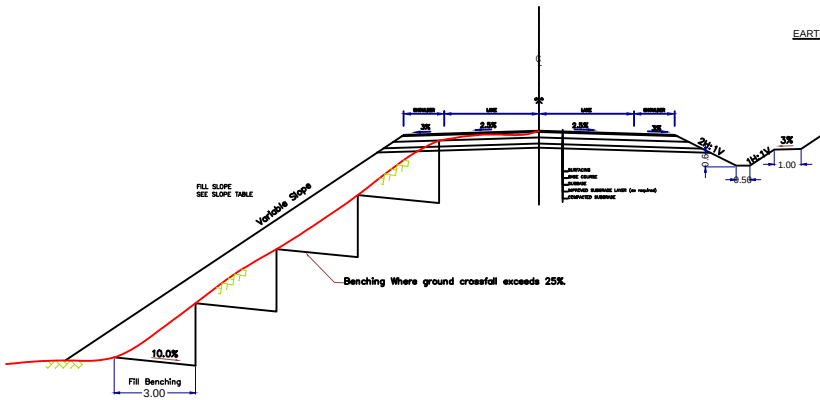
TYPICAL FLAT & ROLLING CROSS SECTION

DRAWN	DY	SCALE:	DRG. NO.
DESIGNED	BJ	AS SHOWN	G – 16b
CHECKED	BJ	DATE	
EDITED	SJURSTEN	15/06/2015	
APPROVED			



Detail-A

Heavy Cuts In Earth & Rock
(For H > 10 Meter)



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TYPICAL MOUNTAINOUS & ESCARPMENT CROSS SECTION

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DESIGNED	BJ	AS SHOWN	G – 16c
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EDITED	SJURSTEN	15/06/2015	
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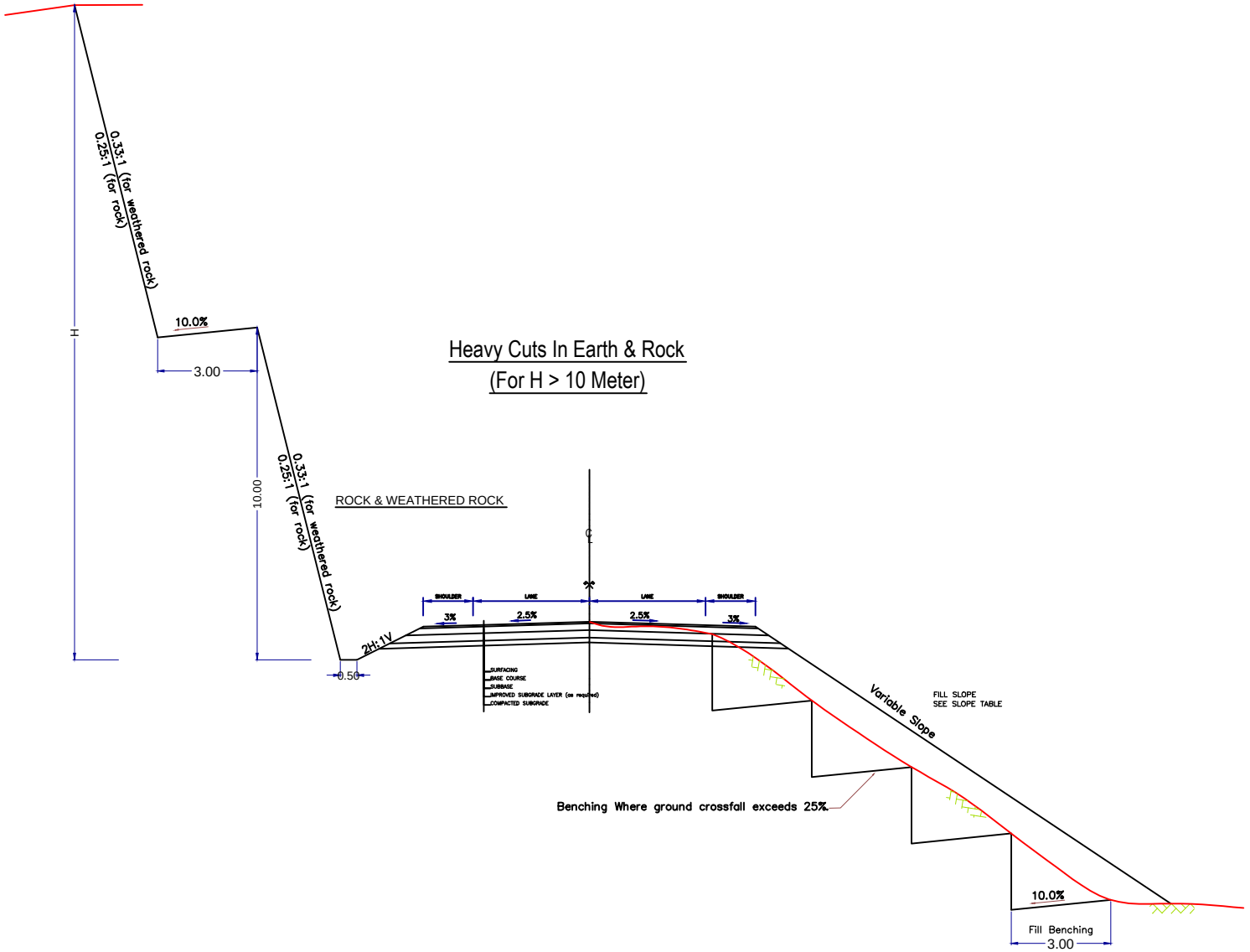
Heavy Cuts In Earth & Rock
(For H > 10 Meter)



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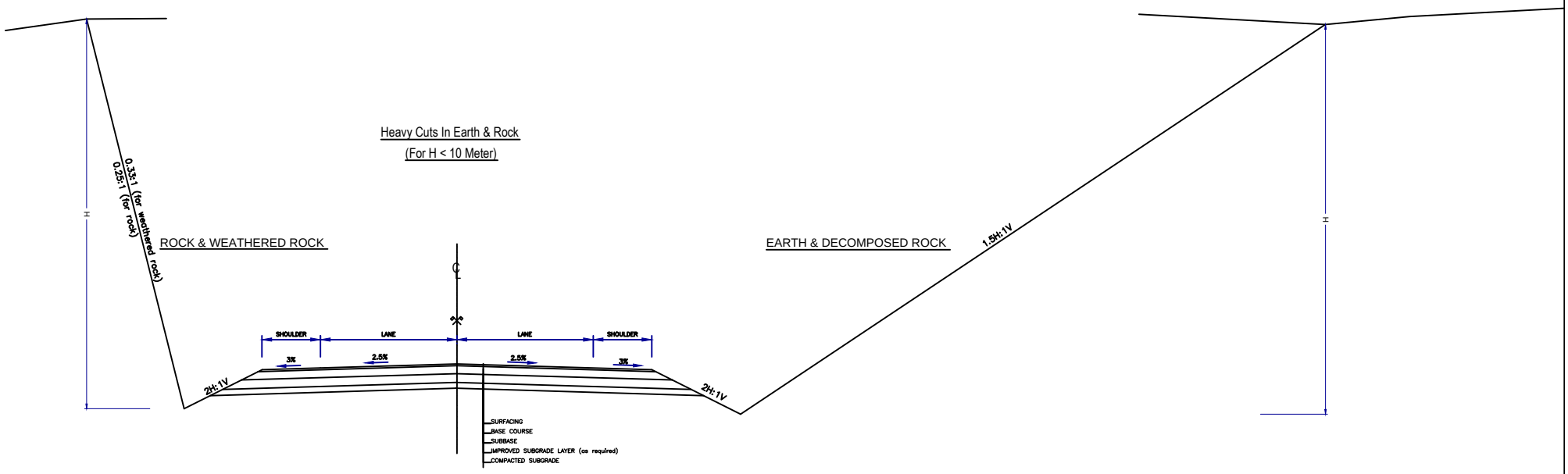
TYPICAL MOUNTAINOUS & ESCARPMENT CROSS SECTION

DRAWN	DY	SCALE:	DRG. NO.
DESIGNED	BJ	AS SHOWN	G – 16d
CHECKED	BJ	DATE	
EDITED	SJKIRSTEN	15/06/2015	
APPROVED			



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TYPICAL MOUNTAINOUS & ESCARPMENT CROSS SECTION

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DESIGNED	BJ		
CHECKED	BJ	DATE 15/06/2015	
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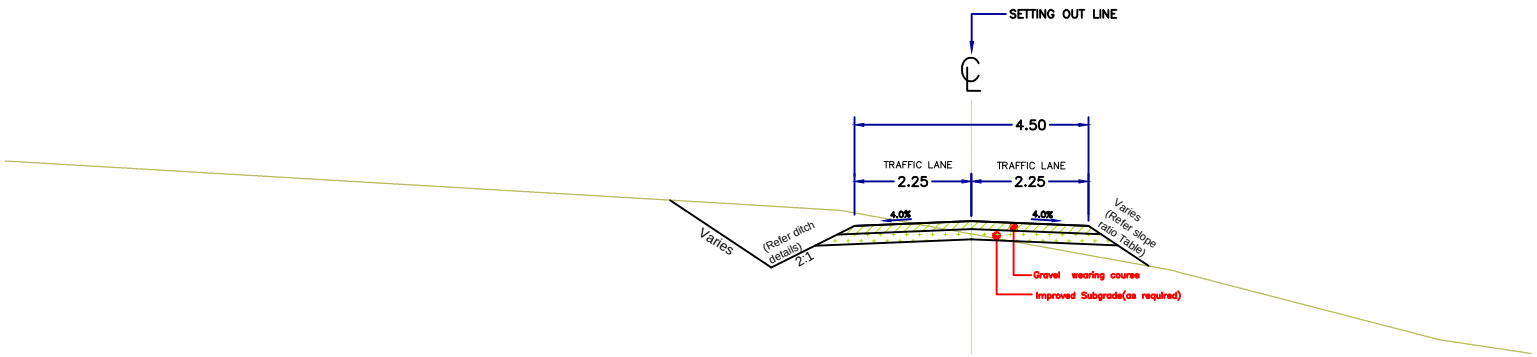

DC1 UNPAVED -TYPICAL NORMAL CROSS SECTION

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TYPICAL CROSS SECTIONS

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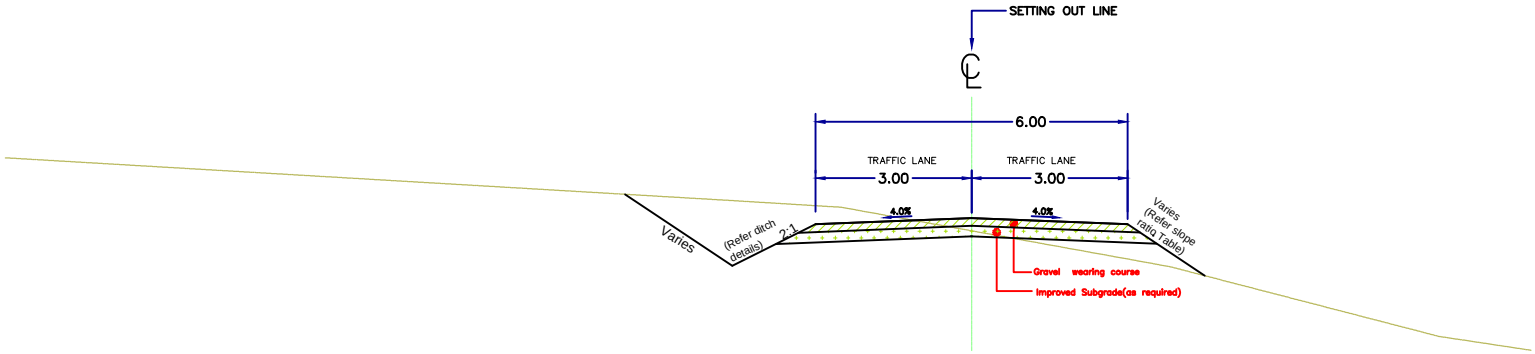

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TYPICAL CROSS SECTIONS

DRAWN	DY	SCALE:	DRG. NO.
DESIGNED	BJ	AS SHOWN	G – 17b
CHECKED	BJ	DATE	
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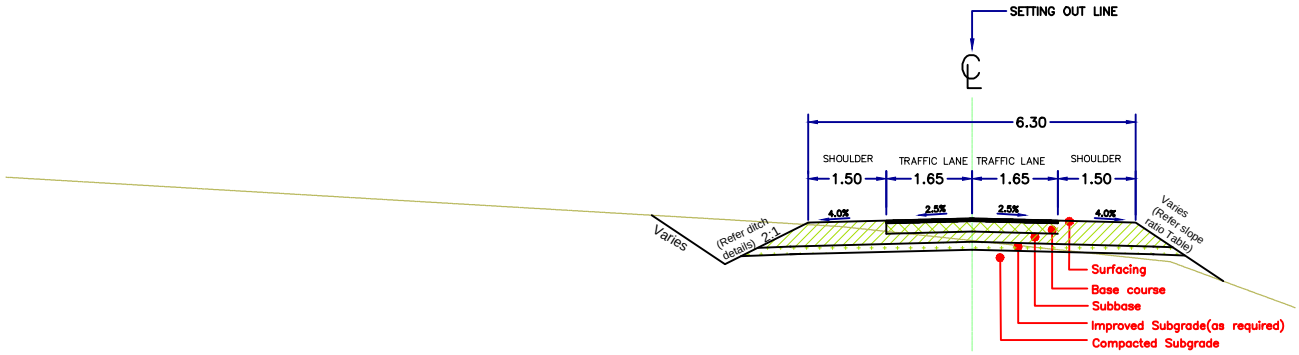
APPROVED			



DC2 PAVED -TYPICAL NORMAL CROSS SECTION

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CHECKED	BJ	DATE 15/06/2015	
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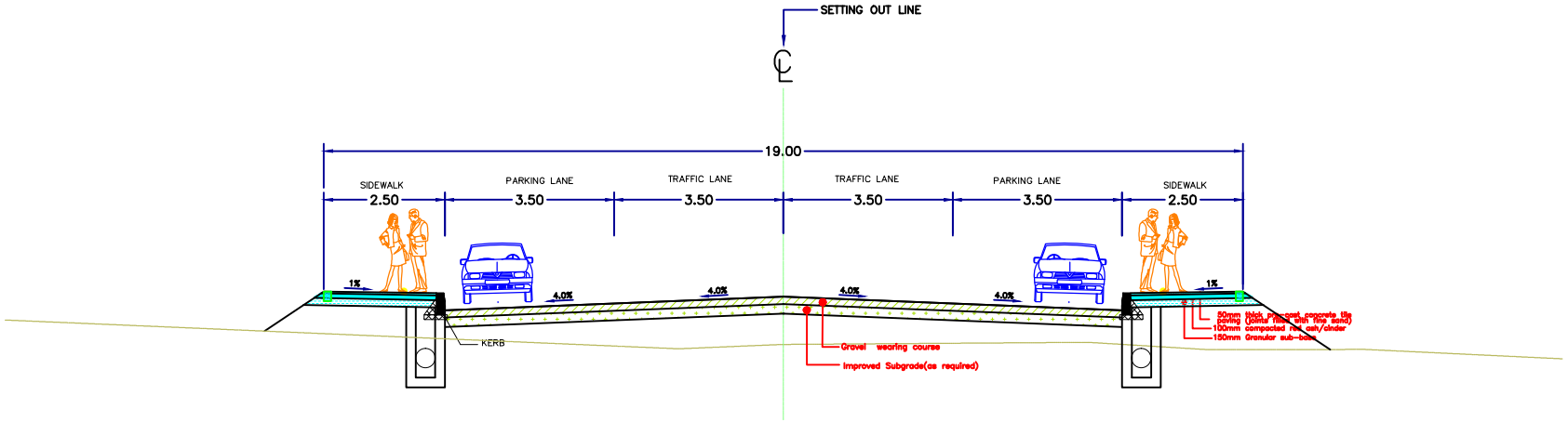

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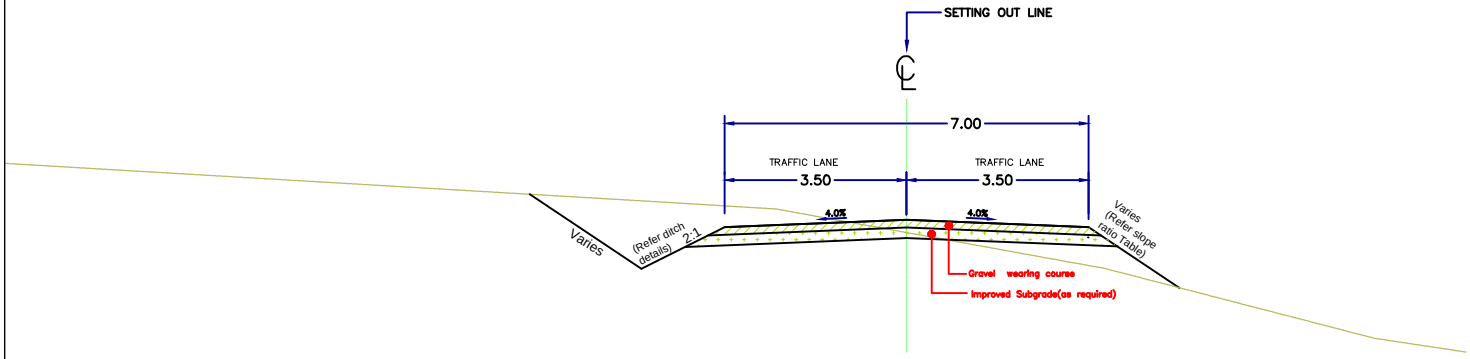

DC3 UNPAVED -TYPICAL NORMAL CROSS SECTION

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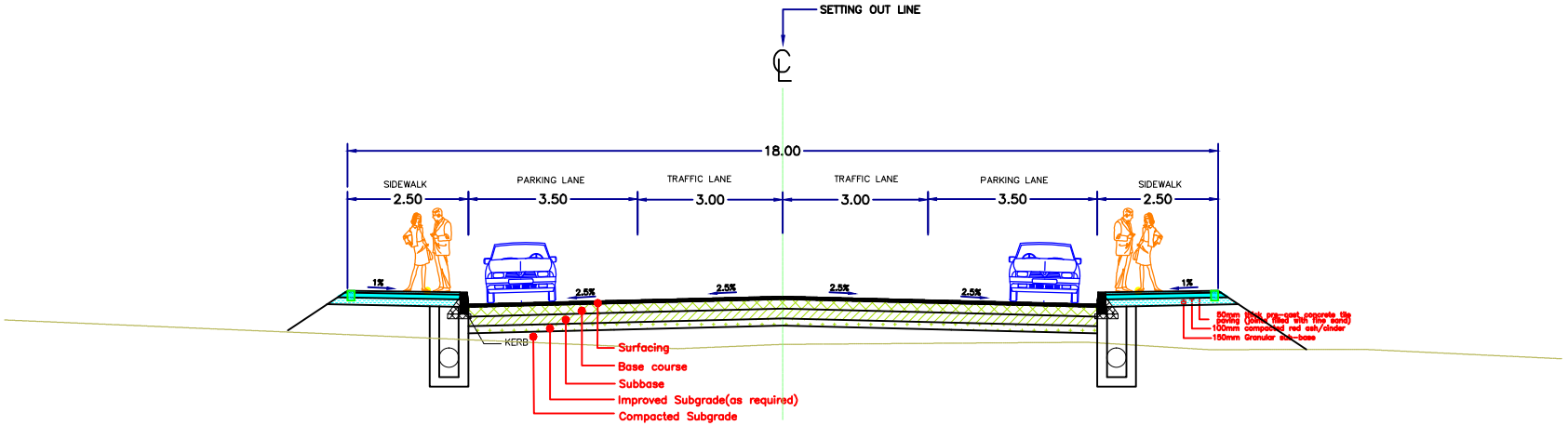

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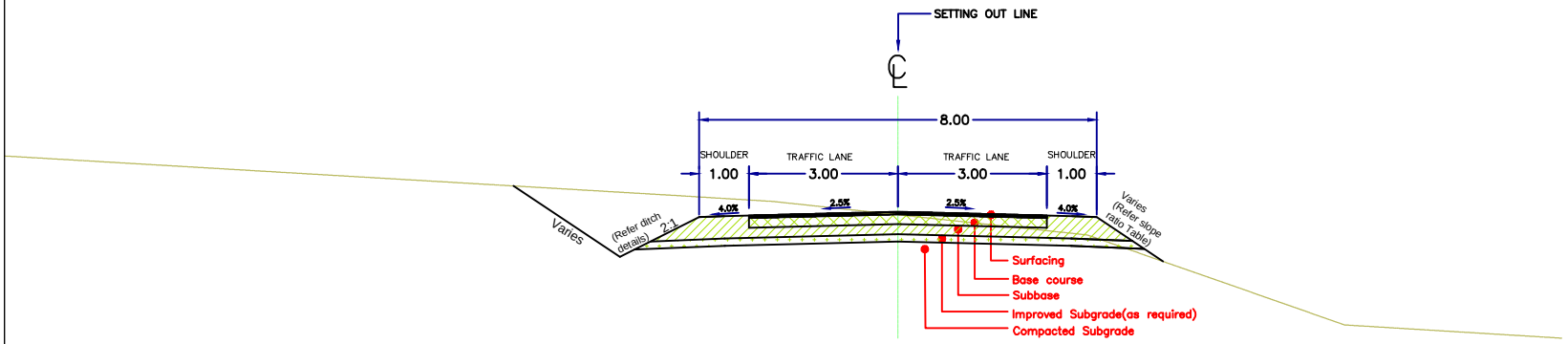

DC3 PAVED -TYPICAL NORMAL CROSS SECTION

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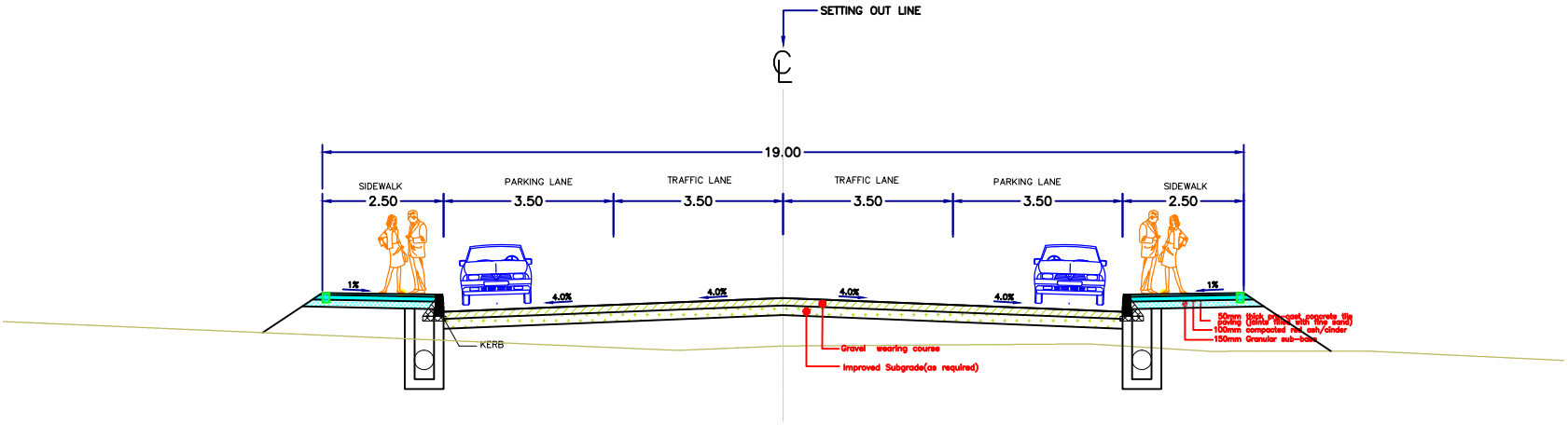
EDITED	SJURSTEN	15/06/2015	
APPROVED			



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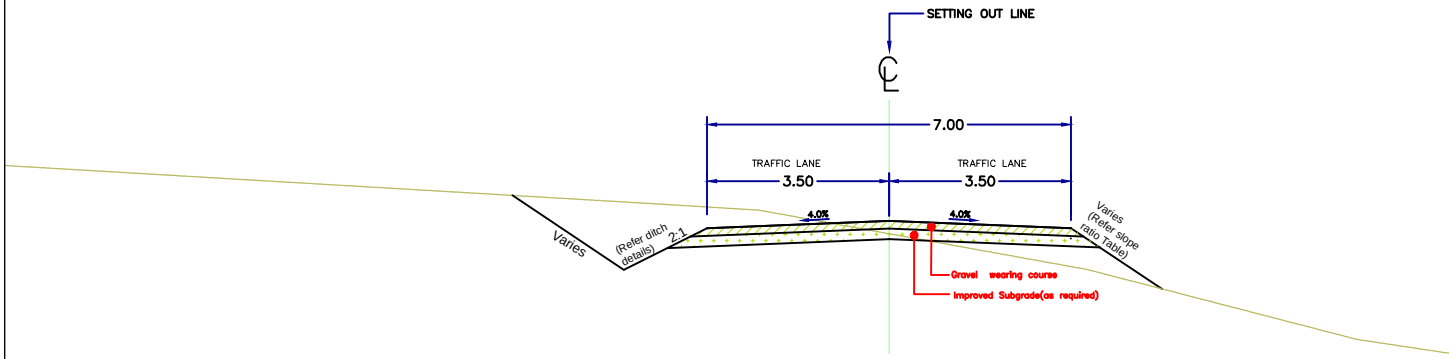

DC4 UNPAVED -TYPICAL NORMAL CROSS SECTION

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TYPICAL CROSS SECTIONS

DRAWN	DY	SCALE:	DRG. NO.
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CHECKED	BJ	DATE	
EDITED	SJKIRSTEN	15/06/2015	
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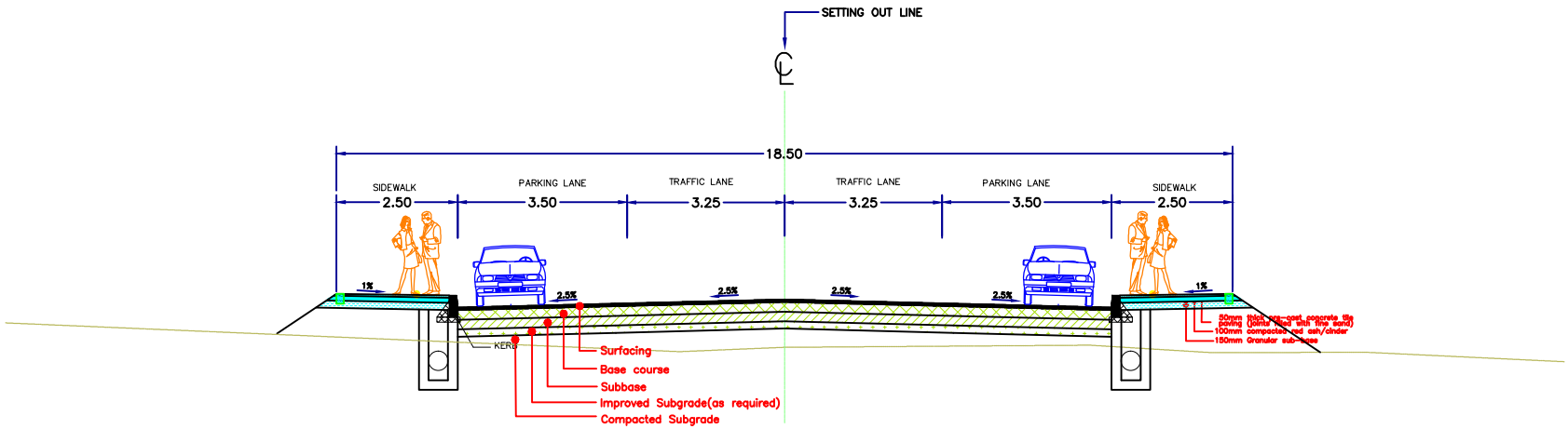

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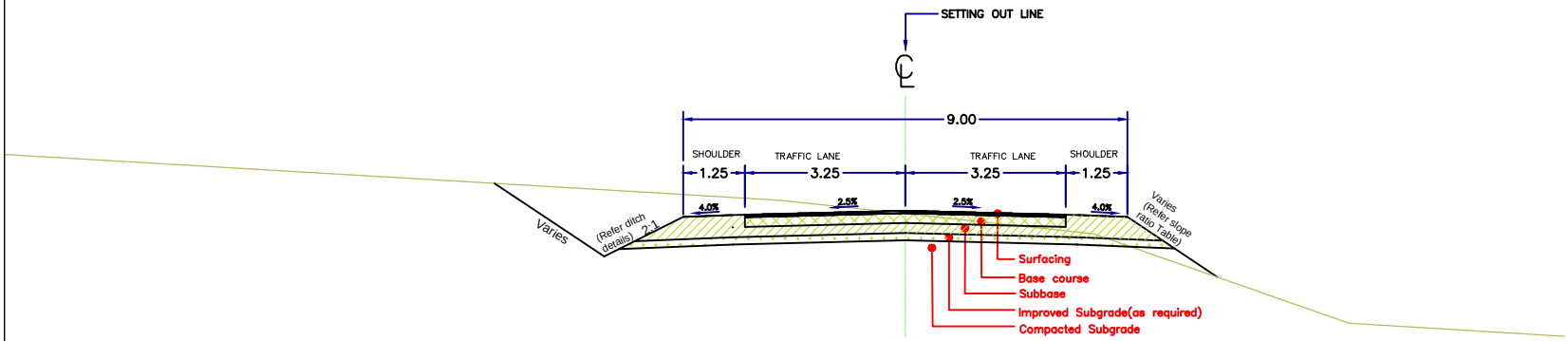

DC4 PAVED -TYPICAL NORMAL CROSS SECTION

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DESIGNED	BJ	AS SHOWN	G – 17g
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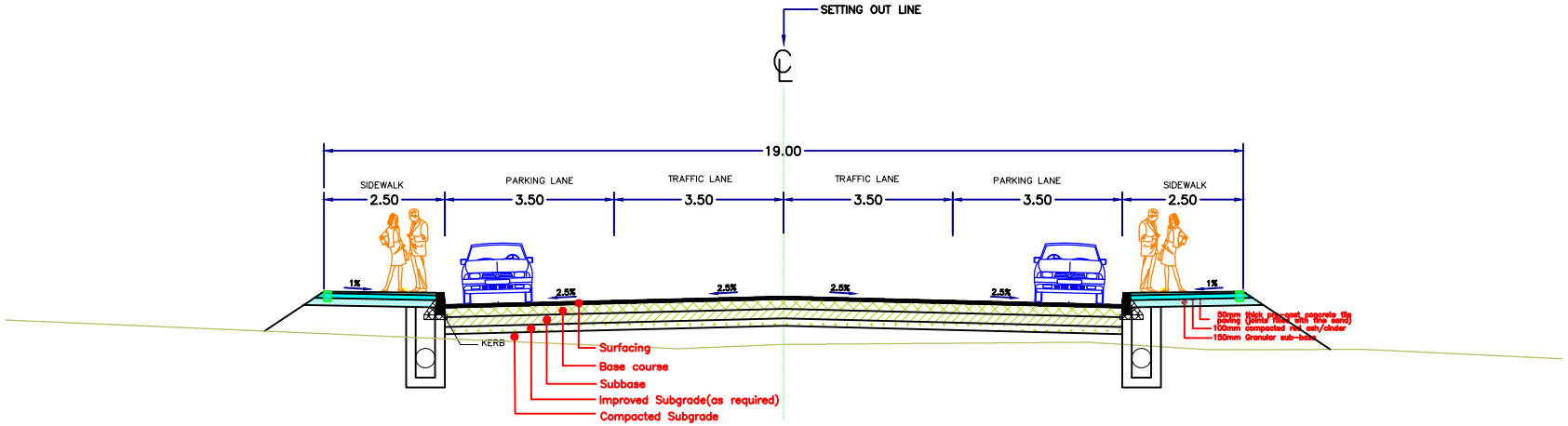

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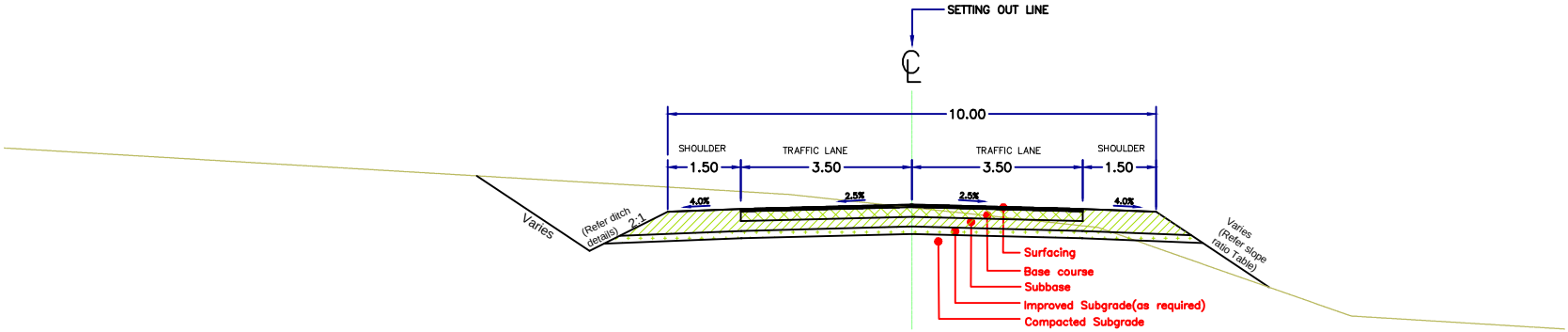

DC5 PAVED -TYPICAL NORMAL CROSS SECTION

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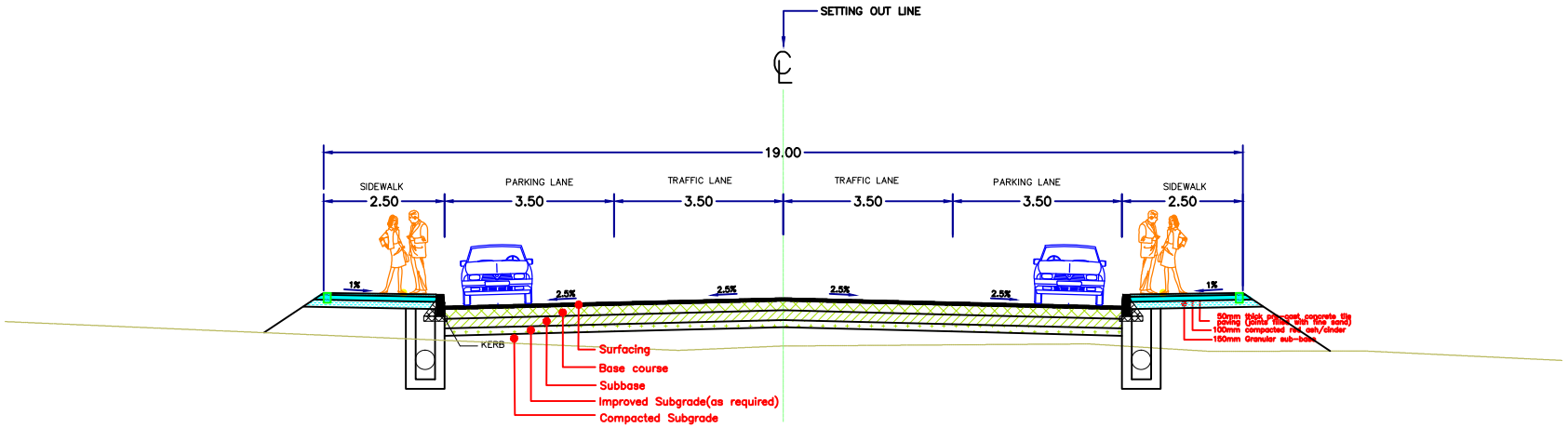

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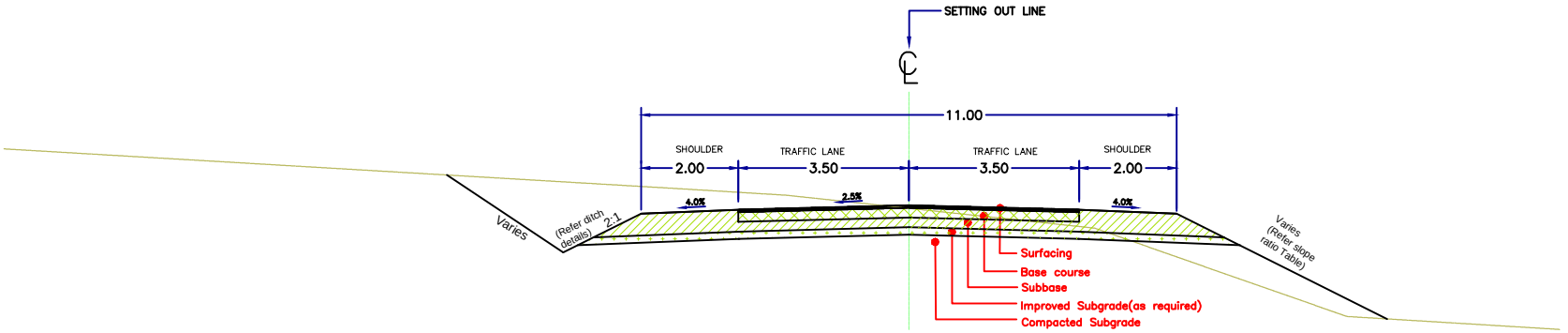

DC6 PAVED -TYPICAL NORMAL CROSS SECTION

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TYPICAL CROSS SECTIONS

DRAWN	DY	SCALE:	DRG. NO.
DESIGNED	BJ	AS SHOWN	G – 17i
CHECKED	BJ	DATE	
EDITED	SJKIRSTEN	15/06/2015	
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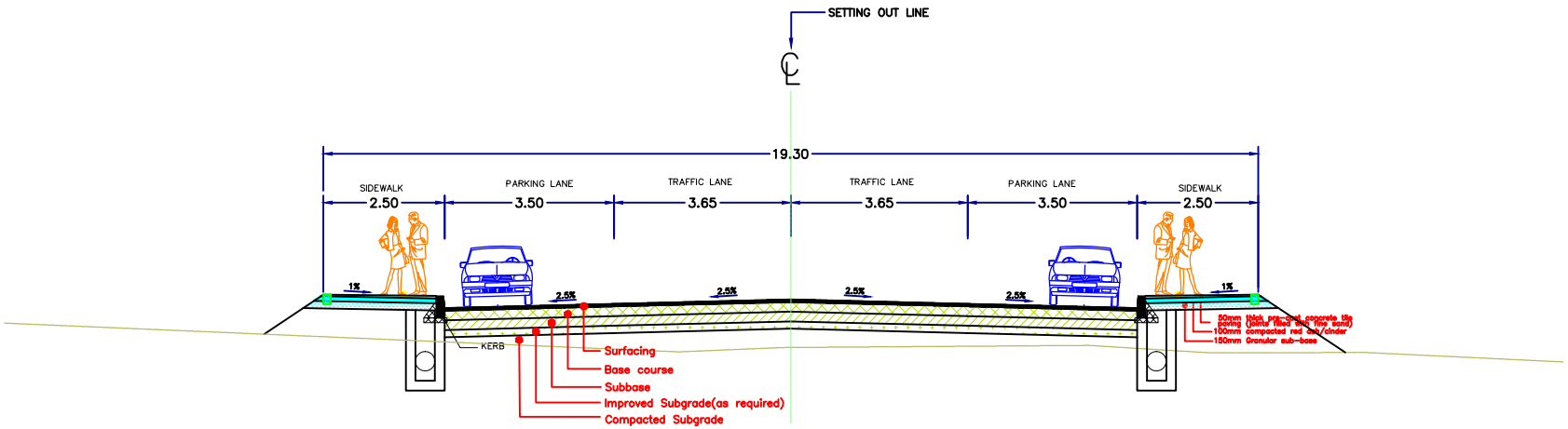

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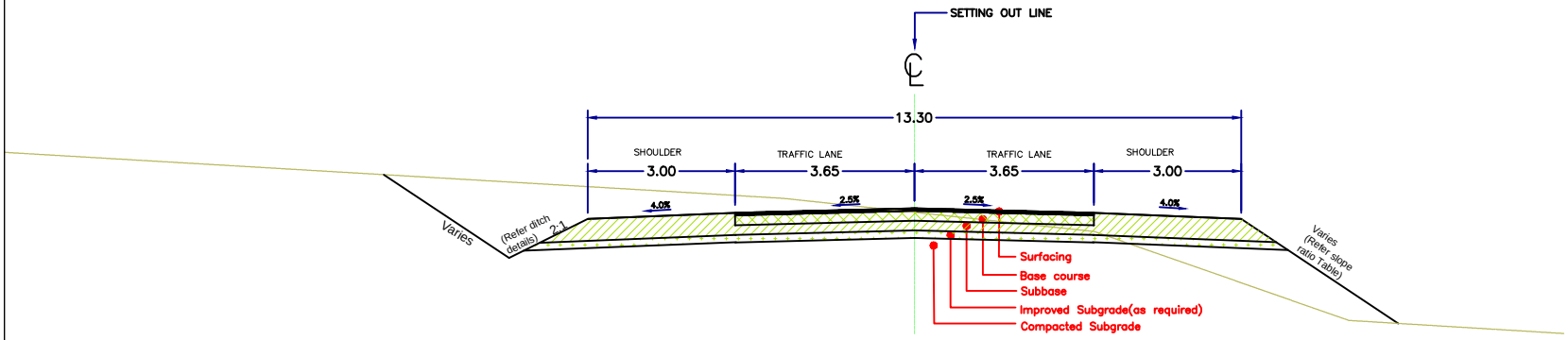

DC7 PAVED -TYPICAL NORMAL CROSS SECTION

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TYPICAL CROSS SECTIONS

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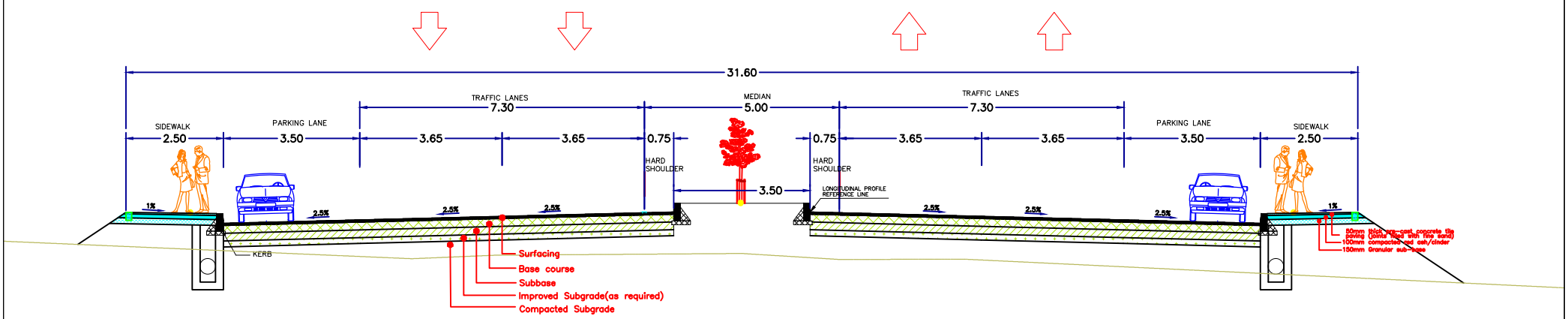

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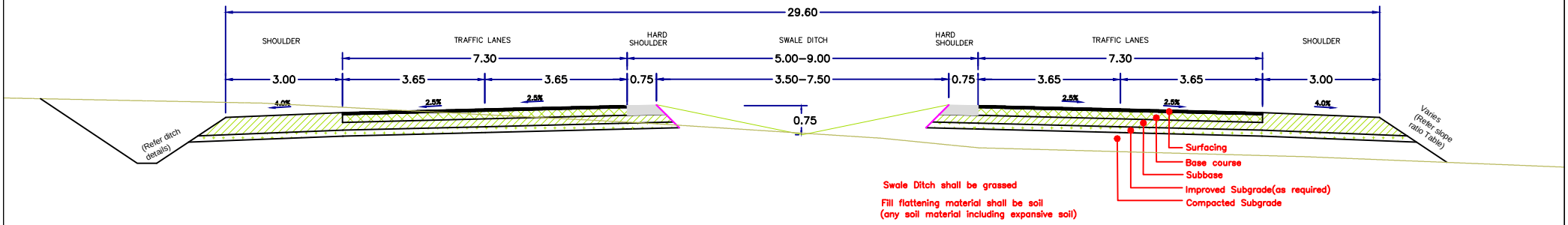

DC8 PAVED -TYPICAL NORMAL CROSS SECTION

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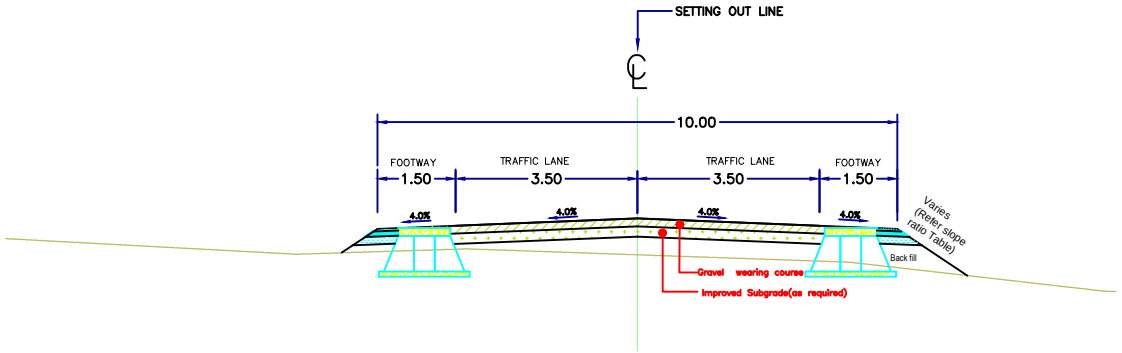
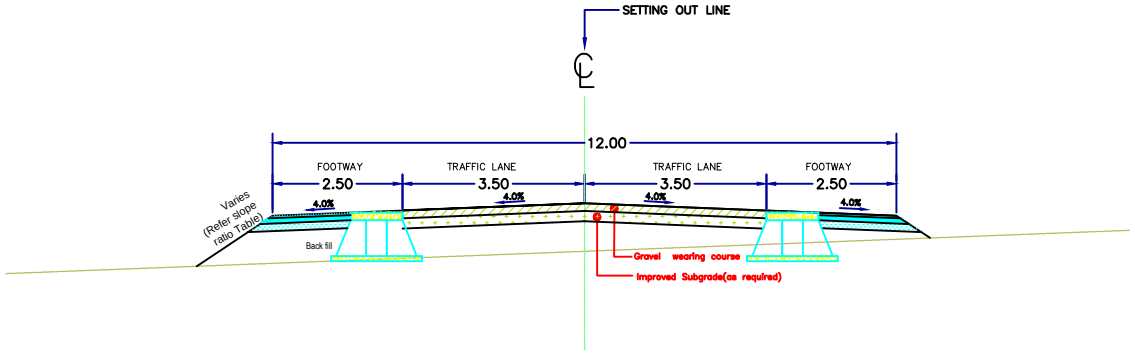
TYPICAL CROSS SECTIONS

DRAWN	DY	SCALE:	DRG. NO.
DESIGNED	BJ	AS SHOWN	G – 17k
CHECKED	BJ	DATE	
EDITED	SJURSTEN	15/06/2015	
APPROVED			



DC1/DC2 UNPAVED -TYPICAL KEBELE SEAT CROSS SECTION



DC3/ DC4 UNPAVED -TYPICAL KEBELE SEAT CROSS SECTION

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

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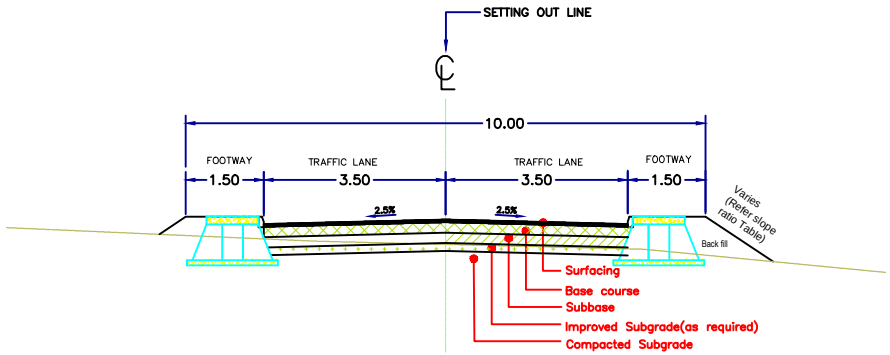
TYPICAL CROSS SECTIONS

DRAWN	DY	SCALE:	DRG. NO.
DESIGNED	BJ	AS SHOWN	G – 171
CHECKED	BJ	DATE	
EDITED	SJKIRSTEN	15/06/2015	
APPROVED			



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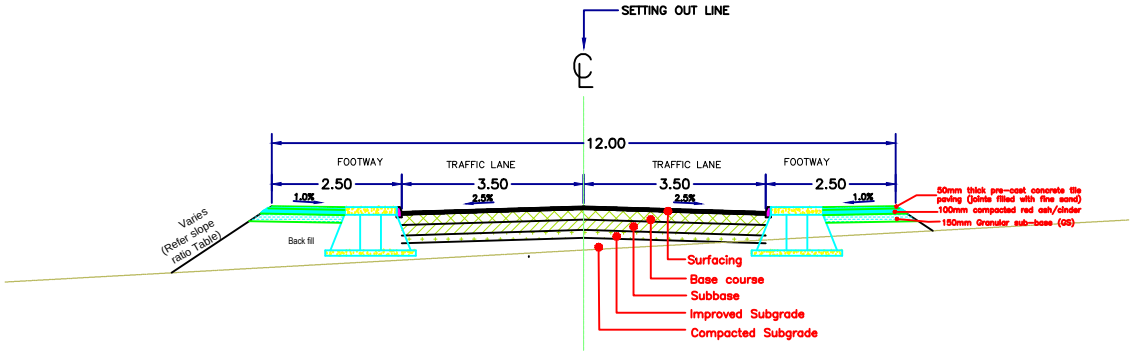

DC3/ DC4/DC5 PAVED -TYPICAL KEBELE SEAT CROSS SECTION

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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B					
A					

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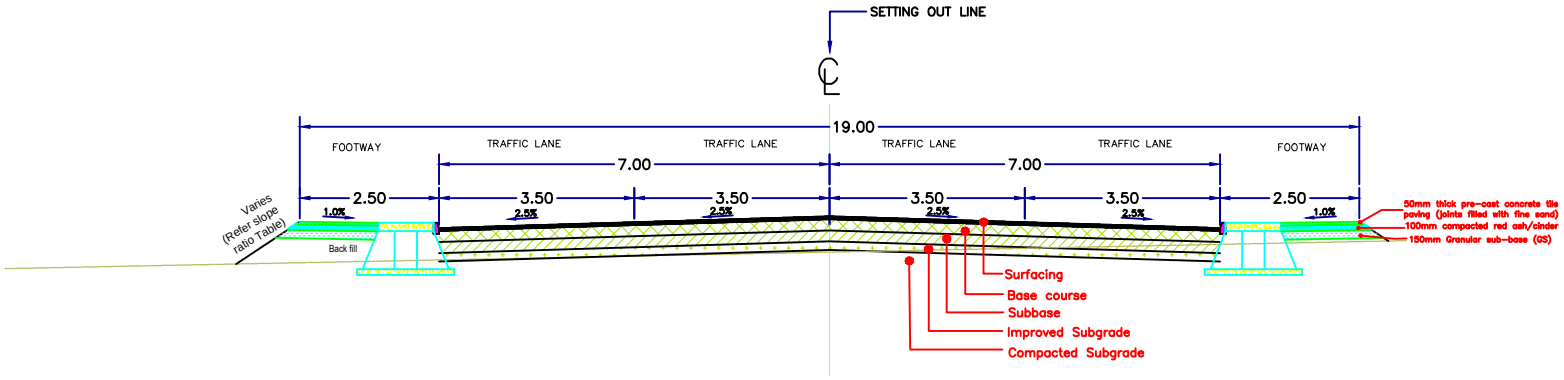
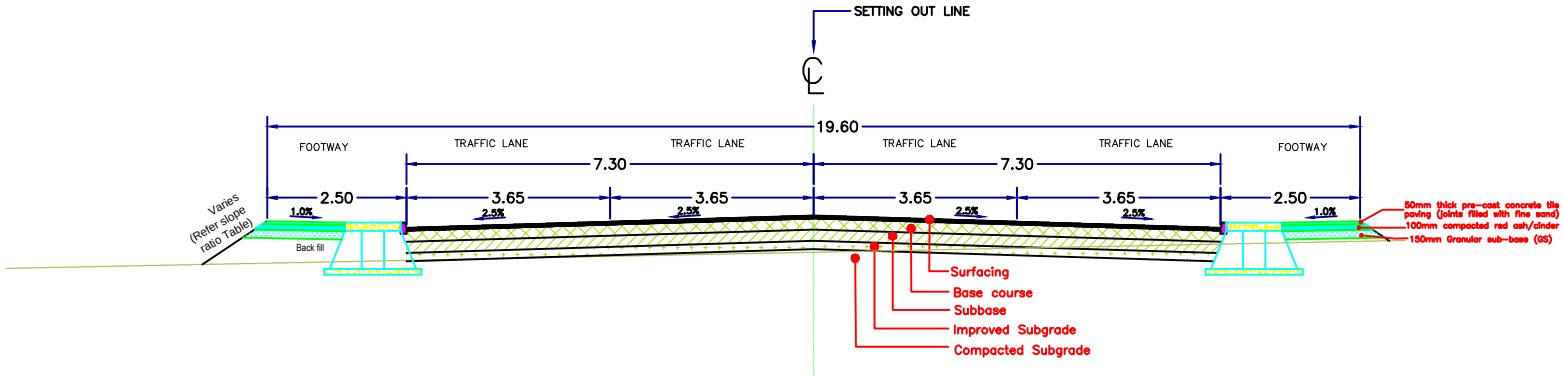
TYPICAL CROSS SECTIONS

DRAWN	DY	SCALE:	DRG. NO.
DESIGNED	BJ	AS SHOWN	G – 17m
CHECKED	BJ	DATE	
EDITED	SJURSTEN	15/06/2015	
APPROVED			



DC6 PAVED -TYPICAL KEBELE SEAT CROSS SECTION



DC7/DC8 PAVED -TYPICAL KEBELE SEAT CROSS SECTION

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
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TYPICAL CROSS SECTIONS

DRAWN	DY	SCALE:	DRG. NO.
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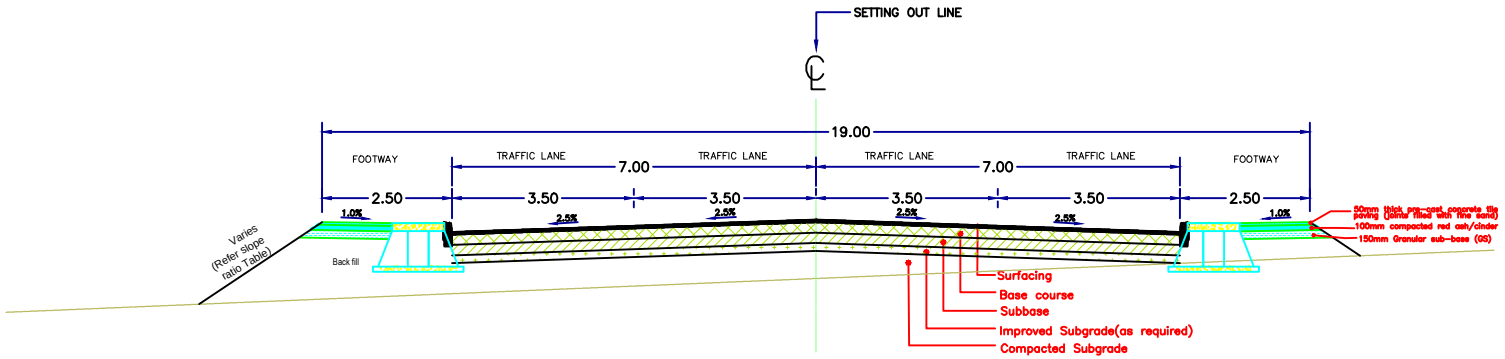
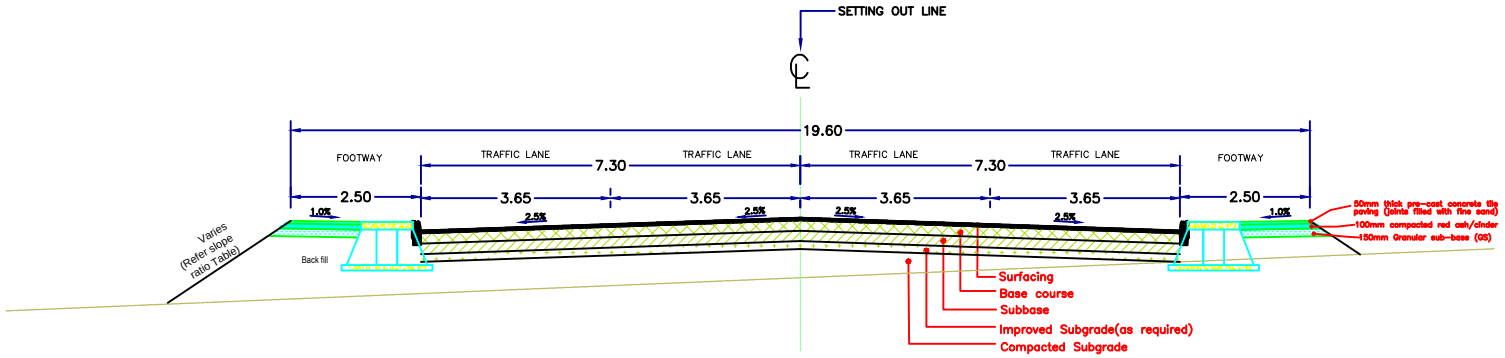
CHECKED	BJ	DATE	
EDITED	S.KIRSTEN	15/06/2015	
APPROVED			



DC3/DC4/DC5/DC6 PAVED -TYPICAL WEREDA SEAT CROSS SECTION



DC7/DC8 PAVED -TYPICAL WEREDA SEAT CROSS SECTION

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
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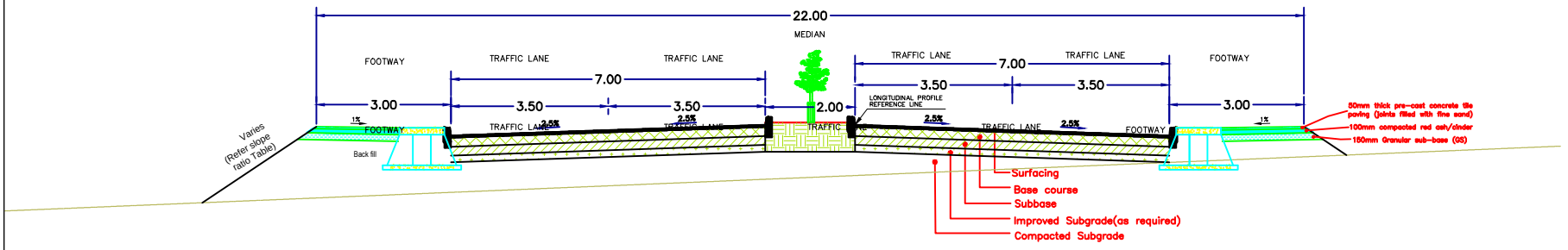
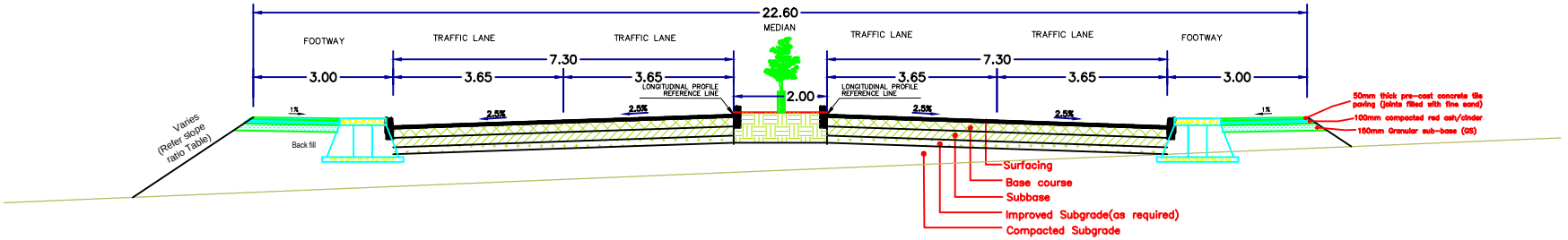
TYPICAL CROSS SECTIONS

DRAWN	DY	SCALE:	DRG. NO.
DESIGNED	BJ	AS SHOWN	G – 17o
CHECKED	BJ	DATE	
EDITED	SJURSTEN	15/06/2015	
APPROVED			



DC3/DC4/DC5/DC6 PAVED -TYPICAL ZONE (REGIONAL) SEAT CROSS SECTION



DC7/DC8 PAVED -TYPICAL ZONE (REGIONAL) SEAT CROSS SECTION

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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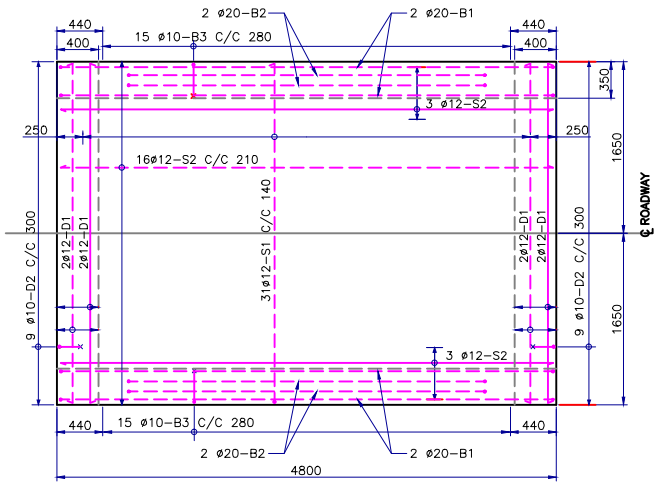
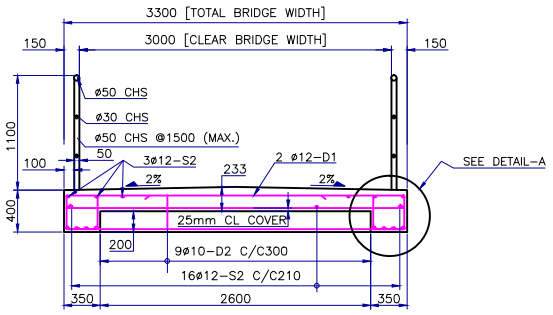
TYPICAL CROSS SECTIONS

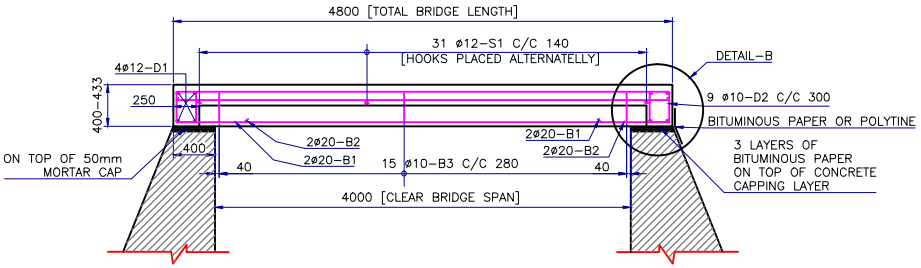
DRAWN	DY	SCALE:	DRG. NO.
DESIGNED	BJ	AS SHOWN	G – 17p
CHECKED	BJ	DATE	
EDITED	SJURSTEN	15/06/2015	
APPROVED			



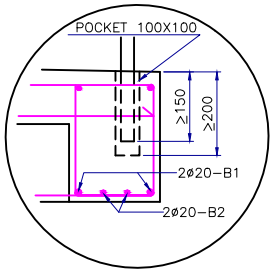
PLAN (SCALE 1:25)



TYPICAL CROSS SECTION (SCALE 1:25)



LONGITUDINAL SECTION (SCALE 1:25)



DETAIL–A (SCALE 1:10)

REINFORCING BAR SCHEDULE

BAR MARK	SIZE (mm)	NUMBER	BAR TYPE	DIMENSIONS (mm) A	B	C	D	E	G	BAR LENGTH (mm)	TOTAL LENGTH (m)	TOTAL WEIGHT (Kg)
B1	20	4	2	320	4700	–	–	–	320	5340	21.36	53.0
B2	20	4	Str.	–	–	–	–	–	–	3820	15.28	38.0
B3	10	30	T1	100	300	330	300	330	100	1460	43.80	27.0
D1	12	8	Str.	–	–	–	–	–	–	3250	26.00	23.0
D2	10	18	T1	100	200	330	200	330	100	1260	22.68	14.0
S1	12	31	32	–	800	130	3250	–	–	4180	129.58	115.0
S2	12	16	Str.	–	–	–	–	–	–	4700	75.20	67.0

REINFORCEMENT STEEL 336 kg. (NOMINAL)
CONCRETE 4.36 m³

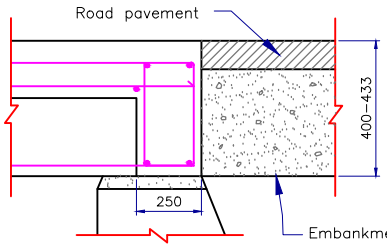
Str.---IMPLIES STRAIGHT BARS.

GENERAL NOTES:

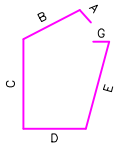
MANUALS USED : THE PREFAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
LOADINGS USED : PEDESTRIAN LOADS ACCORDING TO CHAPTER 3 OF THE ABOVE SPECIFICATIONS.
ALL DIMENSIONS ARE IN MILLIMETERS.
FOR STANDARD BAR DETAILS : SEE DWG NO. B – 28

MATERIAL (STRENGTH) PROPERTIES

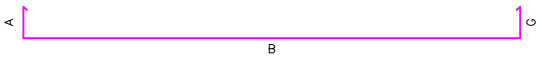
CONCRETE : THE MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS SHALL BE 20MPa (GRADE 20).
PROVIDE FOR 25mm. CHAMFER AT ALL EDGES
REINFORCEMENT STEEL: THE MINIMUM YIELD STRENGTH OF DEFORMED BAR SHALL BE 500 MPA IN ACCORDANCE WITH THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
ALL BAR DIMENSIONS ARE OUT TO OUT
OVERLAP ø12, –300mm. ø16, –400mm. ø32, –1880mm.
FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION



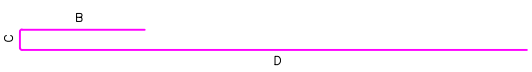
DETAIL–B (SCALE 1:10)



BAR–B3&D2



BAR–B1



BAR–S1

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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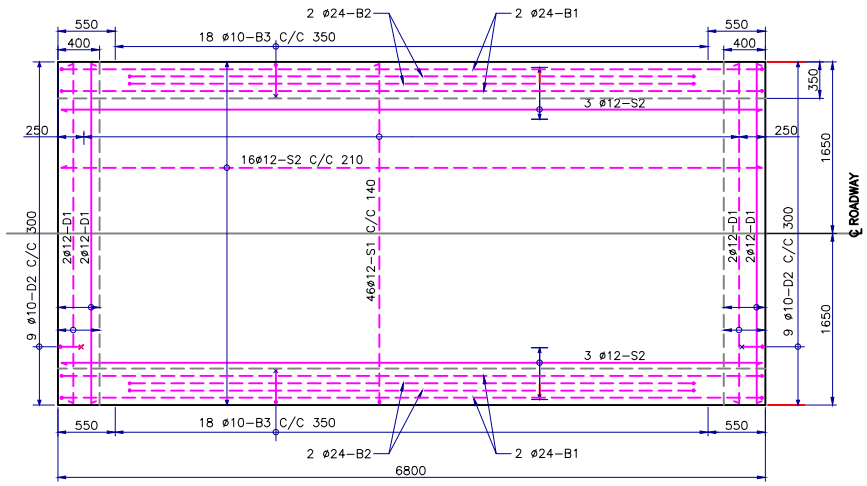
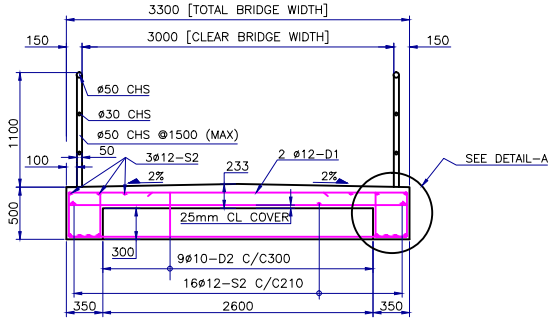
PEDESTRIAN FOOTBRIDGE 4m.–SPAN; WIDTH–3m.

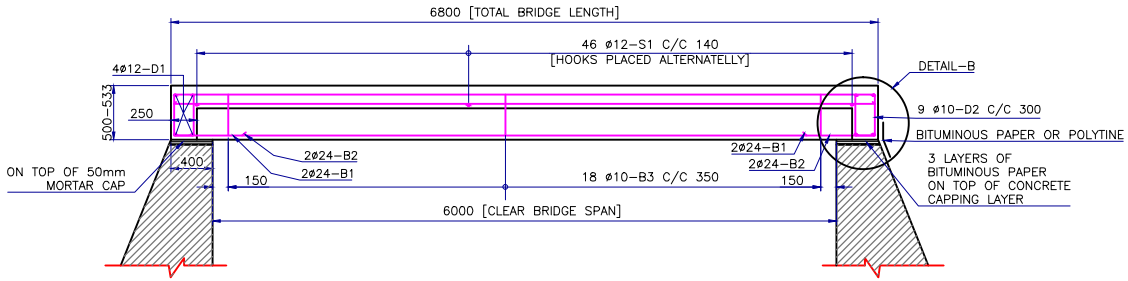
DRAWN	SISAY GETU	SCALE:	DRG. NO.
DESIGNED	HENOK A.	AS SHOWN	P – 01
CHECKED	L. RAHM	DATE	
EDITED	S.JORSTEN	25/12/98	
APPROVED	B.JEBESSA		



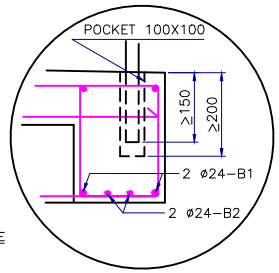
PLAN (SCALE 1:25)



TYPICAL CROSS SECTION (SCALE 1:25)



LONGITUDINAL SECTION (SCALE 1:25)



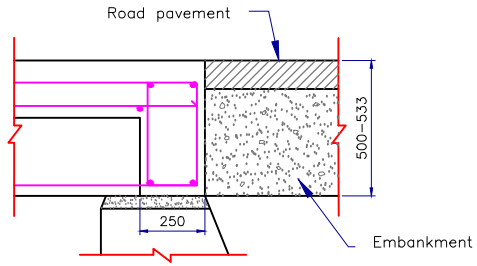
DETAIL–A (SCALE 1:10)

REINFORCING BAR SCHEDULE

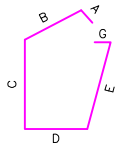
BAR MARK	SIZE (mm)	NUMBER	BAR TYPE	DIMENSIONS (mm) A	B	C	D	E	G	BAR LENGTH (mm)	TOTAL LENGTH (m)	TOTAL WEIGHT (Kg)
B1	24	4	2	385	6700	–	–	–	385	7470	29.88	106.0
B2	24	4	Str.	–	–	–	–	–	–	5430	21.72	77.0
B3	10	36	T1	100	300	430	300	430	100	1660	59.76	37.0
D1	12	8	Str.	–	–	–	–	–	–	3250	26.00	23.0
D2	10	18	T1	100	200	430	200	430	100	1460	26.28	16.0
S1	12	46	32	–	800	130	3250	–	–	4180	192.28	171.0
S2	12	16	Str.	–	–	–	–	–	–	6700	107.20	95.0

REINFORCEMENT STEEL 525 Kg. (NOMINAL)
CONCRETE 8.90 m3

Str.---IMPLIES STRAIGHT BARS.

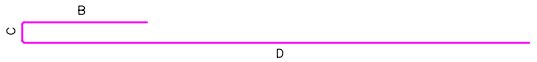


DETAIL–B (SCALE 1:10)



BAR–B3&D2

BAR–B1



BAR–S1

GENERAL NOTES:

MANUALS USED : THE PREVAILING VERSION OF THE ERA ERA BRIDGE DESIGN MANUAL
LOADINGS USED : PEDESTRIAN LOADS ACCORDING TO CHAPTER 3 OF THE ABOVE SPECIFICATIONS.
ALL DIMENSIONS ARE IN MILLIMETERS.
FOR STANDARD BAR DETAILS : SEE DWG NO. B – 28

MATERIAL (STRENGTH) PROPERTIES

CONCRETE : THE MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS SHALL BE 20MPa (GRADE 20).
PROVIDE FOR 25mm. CHAMFER AT ALL EDGES
REINFORCEMENT STEEL: THE MINIMUM YIELD STRENGTH OF DEFORMED BAR SHALL BE 500 MPA IN ACCORDANCE WITH THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
ALL BAR DIMENSIONS ARE OUT TO OUT
OVERLAP ø12, –300mm. ø16, –400mm. ø32, –1880mm.
FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

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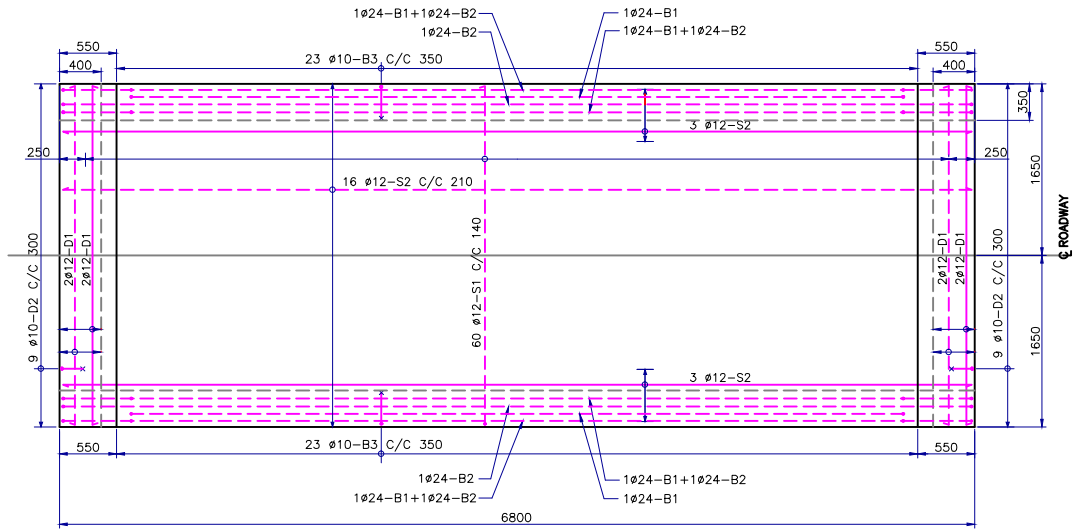
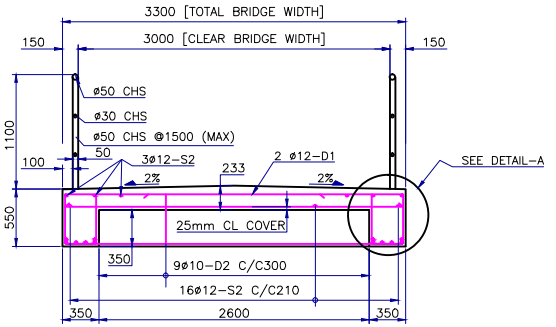
PEDESTRIAN FOOTBRIDGE 6m.–SPAN; WIDTH–3m.

DRAWN	SISAY GETU	SCALE:	DRG. NO.
DESIGNED	HENOK A.	AS SHOWN	P – 02
CHECKED	L. RAHM	DATE	
EDITED	S.WORSTEN	25/12/98	
APPROVED	B.JEBESSA		



PLAN (SCALE 1:25)



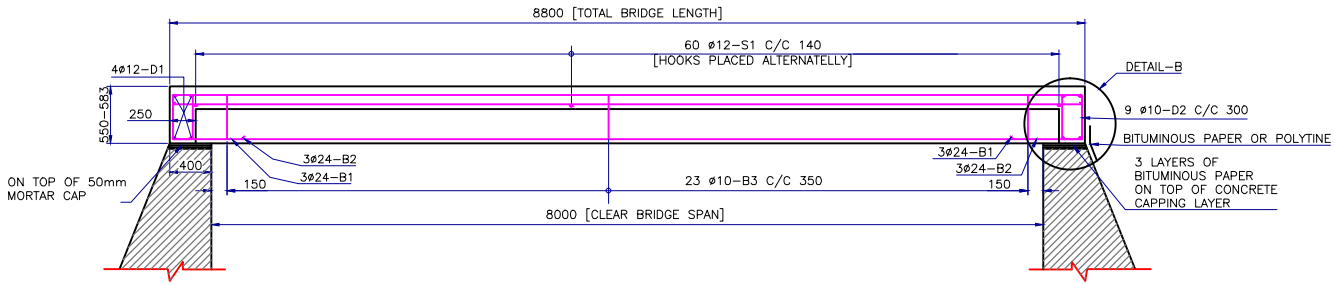
TYPICAL CROSS SECTION (SCALE 1:25)

REINFORCING BAR SCHEDULE

BAR MARK	SIZE (mm)	NUMBER	BAR TYPE	DIMENSIONS (mm) A	B	C	D	E	G	BAR LENGTH (mm)	TOTAL LENGTH (m)	TOTAL WEIGHT (Kg)
B1	24	6	2	385	8700	–	–	–	385	9470	56.82	202.0
B2	24	6	Str.	–	–	–	–	–	–	6890	41.34	147.0
B3	10	46	T1	100	300	480	300	480	100	1760	80.96	50.0
D1	12	8	Str.	–	–	–	–	–	–	3250	26.00	23.0
D2	10	18	T1	100	200	480	200	480	100	1560	28.08	17.0
S1	12	60	32	–	800	130	3250	–	–	4180	250.80	223.0
S2	12	16	Str.	–	–	–	–	–	–	8700	139.20	124.0

REINFORCEMENT STEEL 785 kg. (NOMINAL)
CONCRETE 8.90 m³

Str.---IMPLIES STRAIGHT BARS.



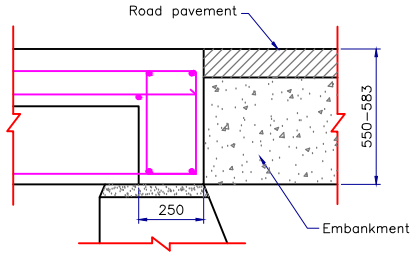
LONGITUDINAL SECTION (SCALE 1:25)

GENERAL NOTES:

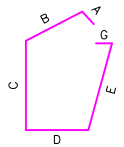
MANUALS USED : THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
LOADINGS USED : PEDESTRIAN LOADS ACCORDING TO CHAPTER 3 OF THE ABOVE SPECIFICATIONS.
ALL DIMENSIONS ARE IN MILLIMETERS.
FOR STANDARD BAR DETAILS : SEE DWG NO. B – 28

MATERIAL (STRENGTH) PROPERTIES

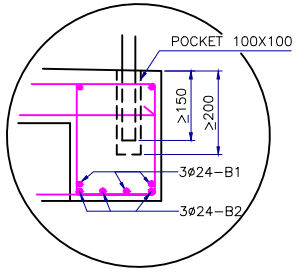
CONCRETE : THE MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS SHALL BE 20MPa (GRADE 20).
PROVIDE FOR 25mm. CHAMFER AT ALL EDGES
REINFORCEMENT STEEL : THE MINIMUM YIELD STRENGTH OF DEFORMED BAR SHALL BE 500 MPA IN ACCORDANCE WITH THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
ALL BAR DIMENSIONS ARE OUT TO OUT
OVERLAP ø12, –300mm. ø16, –400mm. ø32, –1880mm.
FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION



DETAIL–B (SCALE 1:10)

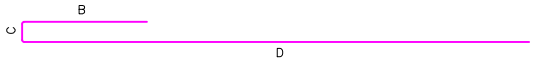


BAR–B3&D2



DETAIL–A (SCALE 1:10)

BAR–B1



BAR–S1

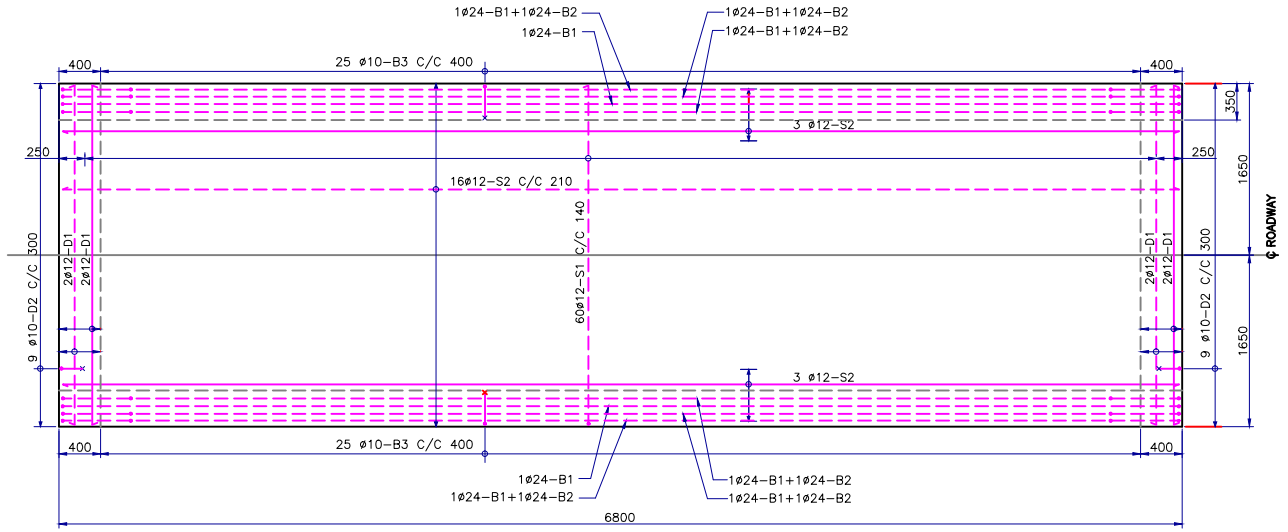
NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

REVISIONS

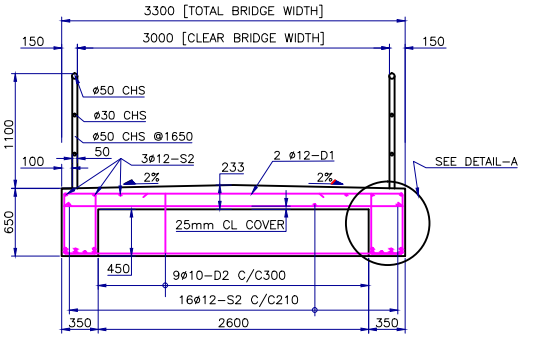
THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
ETHIOPIAN ROADS AUTHORITY
Post Office Box 1770 Addis Ababa Ethiopia
Cable Address Highways Addis Ababa
Telex 21180 Tel.No. 51–71–70/79

PEDESTRIAN FOOTBRIDGE 8m.–SPAN; WIDTH–3m.

DRAWN	SISAY GETU	SCALE:	DRG. NO.
DESIGNED	HENOK A.	AS SHOWN	
CHECKED	L. RAHM	DATE	P – 03
EDITED	S.WORSTEN	25/12/98	
APPROVED	B.JEBESSA		



PLAN (SCALE 1:25)



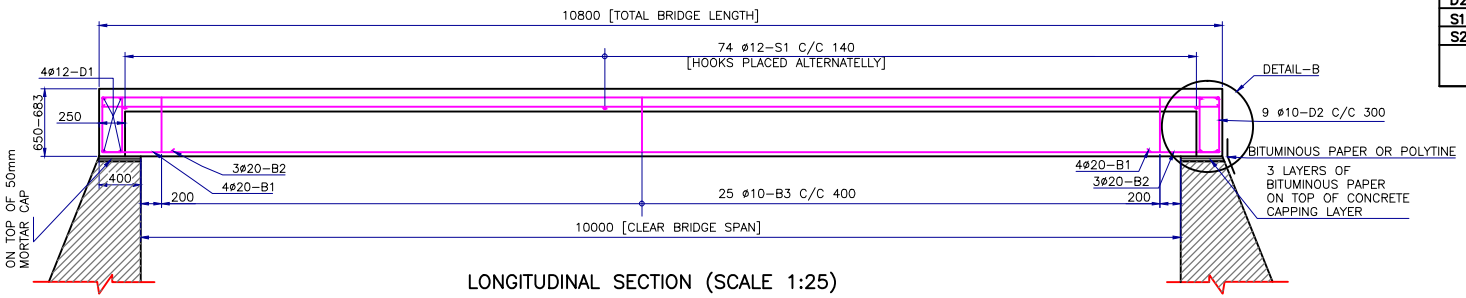
TYPICAL CROSS SECTION (SCALE 1:25)

REINFORCING BAR SCHEDULE

BAR MARK	SIZE (mm)	NUMBER	BAR TYPE	DIMENSIONS (mm) A	B	C	D	E	G	BAR LENGTH (mm)	TOTAL LENGTH (m)	TOTAL WEIGHT (Kg)
B1	24	8	2	385	10700	–	–	–	385	10470	83.76	297.0
B2	24	6	Str.	–	–	–	–	–	–	8490	50.94	181.0
B3	10	50	T1	100	300	580	300	580	100	1960	98.00	60.0
D1	12	8	Str.	–	–	–	–	–	–	3250	26.00	23.0
D2	10	18	T1	100	200	580	200	580	100	1760	31.68	20.0
S1	12	74	32	–	800	130	3250	–	–	4180	309.32	275.0
S2	12	16	Str.	–	–	–	–	–	–	10700	171.20	152.0

REINFORCEMENT STEEL 1008 kg. (NOMINAL)
CONCRETE 8.90 m3

Str.---IMPLIES STRAIGHT BARS.



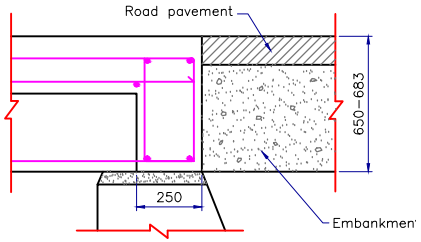
LONGITUDINAL SECTION (SCALE 1:25)

GENERAL NOTES:

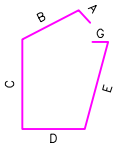
MANUALS USED : THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
LOADINGS USED : PEDESTRIAN LOADS ACCORDING TO CHAPTER 3 OF THE ABOVE SPECIFICATIONS.
ALL DIMENSIONS ARE IN MILLIMETERS.
FOR STANDARD BAR DETAILS : SEE DWG NO. B – 28

MATERIAL (STRENGTH) PROPERTIES

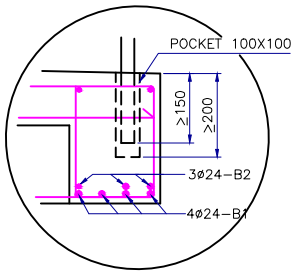
CONCRETE : THE MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS SHALL BE 20MPa (GRADE 20).
PROVIDE FOR 25mm. CHAMFER AT ALL EDGES
REINFORCEMENT STEEL: THE MINIMUM YIELD STRENGTH OF DEFORMED BAR SHALL BE 500 MPA IN ACCORDANCE WITH THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL
ALL BAR DIMENSIONS ARE OUT TO OUT
OVERLAP ø12, –300mm. ø16, –400mm. ø32, –1880mm.
FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION



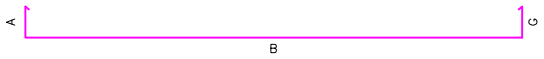
DETAIL–B (SCALE 1:10)



BAR–B3&D2



DETAIL–A (SCALE 1:10)



BAR–B1

BAR–S1

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

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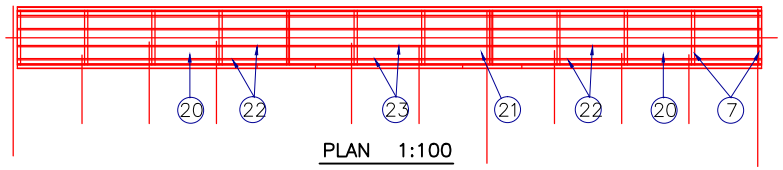
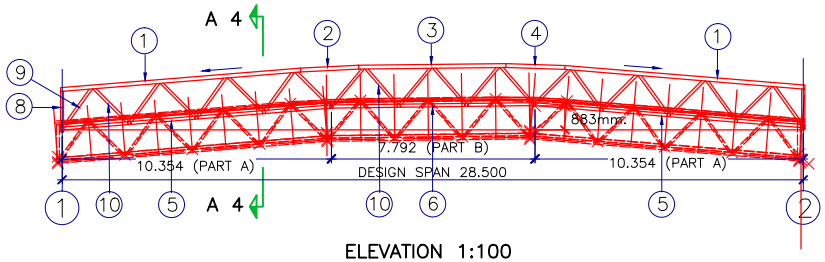
ETHIOPIAN ROADS AUTHORITY
Post Office Box 1770 Addis Ababa Ethiopia
Cable Address Highways Addis Ababa
Telex 21180 Tel.No. 51–71–70/79

PEDESTRIAN FOOTBRIDGE 10m.–SPAN; WIDTH–3m.

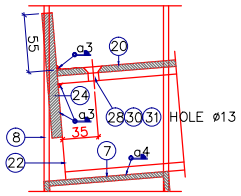
DRAWN	SISAY GETU	SCALE:	DRG. NO.
DESIGNED	HENOK A.	AS SHOWN	P – 04
CHECKED	L. RAHM	DATE	
EDITED	S.WORSTEN	25/12/98	
APPROVED	B.JEBESSA		



PLAN 1:100



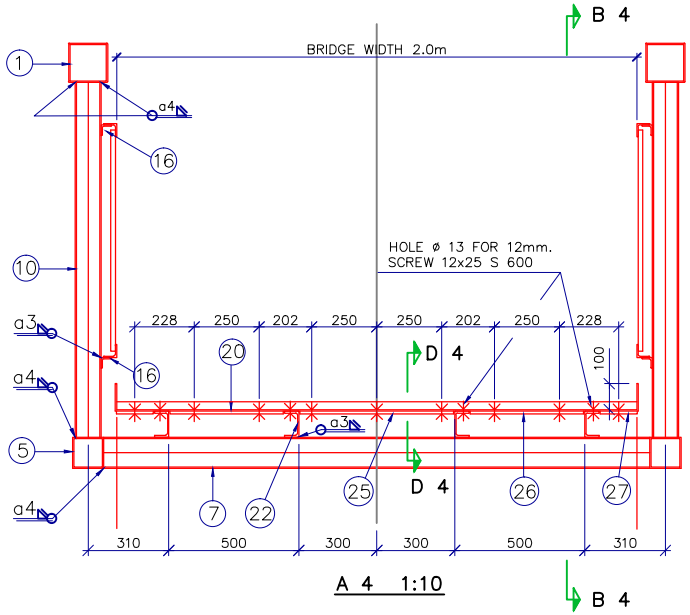
ELEVATION 1:100



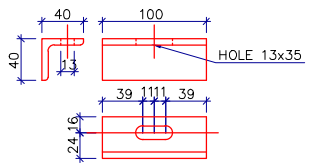
E 4 1:25

ITEM	NO	STEEL SHAPE/DIMENSION	LENGTH	QUALITY	WEIGHT	NOTE
1	4	KKR 150x150x5 COLD FORMED	9262	S355	205	
2	2	KKR 150x150x5 COLD FORMED	2240	"	50	
3	2	KKR 150x150x6.3 COLD FORMED	5663	"	155	
4	2	KKR 150x150x5 COLD FORMED	2279	"	50	
5	4	KKR 120x120x5 COLD FORMED	10330	"	180	
6	2	KKR 120x120x5 COLD FORMED	7802	"	136	
7	12	KKR 120x120x5 COLD FORMED	2100	"	37	
8	4	KKR 120x120x5 COLD FORMED	1549	"	27	
9	4	KKR 100x100x5 COLD FORMED	1833	"	26	
10	40	KKR 100x100x5 COLD FORMED	1877	"	27	
11	4	PL 142x3 STEEL PLATE	142	S275	0.5	
15	4	PL 30x130 STEEL PLATE	310	"	10	
16	48	L 40x40x6 ANGLE IRON	100	"	0.4	
18	8	PL 3x30	110	"	0.1	
20	2	PL 2200x6	10430	"	1101	
21	1	PL 2200x6	7820	"	826	
22	8	UNP 100	10380	"	100	
23	4	UNP 100	7810	"	75	
24	2	PL 10x120	2100	"	20	
25	2	PL 10x50	591	"	2	
26	4	PL 10x50	436	"	2	
27	4	PL 10x50	142	"	1	
28	196	FLAT SCREW 12x25 FZB		8.8		
29	18	FLAT SCREW 12x30 FZB		8.8		
30	214	NUT M12 FZV		8.8		
31	214	WASHER 13x22 FZV		HB200		
32	8	SCREW M24x70 FZV		8.8		
33	8	NUT M24 FZV		8.8		
34	16	WASHER 25x45 FZV		HB200		
			TOTAL WEIGHT		8362 KG	

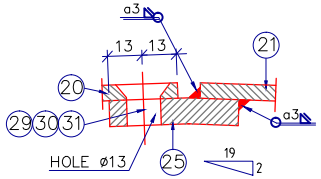
* S355=FE360B FN ACC. TO EN10 025 AND EN10219-1, EQUAL TO AASHTO M270M GRADE 345=A709M GRADE 345



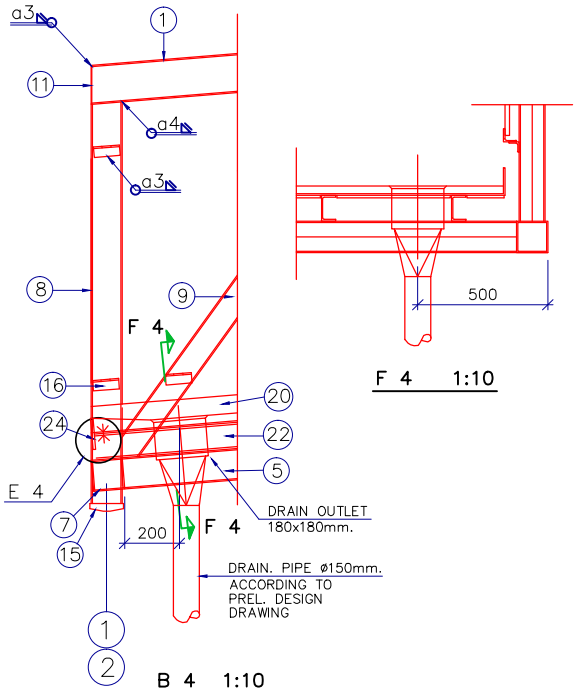
A 4 1:10



C 4 1:2.5
ITEM 16



D 4 1:1



B 4 1:10

F 4 1:10

GENERAL NOTES:

DESIGN LOADS: THE BRIDGE IS DESIGNED ACCORDING TO THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL, FOR 4kN/m2

DESIGN SPECIFICATIONS: PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL AND EBCS NR4 STEEL DESIGN.

CONSTRUCTION: THE BRIDGE SHALL BE CONSTRUCTED ACCORDING TO THE PREVAILING VERSION OF THE ERA ROAD AND BRIDGE SPECIFICATIONS

REQUIREMENTS

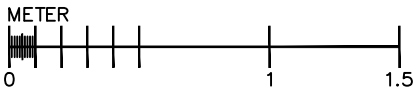
SURFACE COATING:

-CORROSION PROTECTION: TO BE MADE BEFORE ASSEMBLING THE PARTS. PREPARATION OF THE SURFACES BY ABRASIVE BLASTING OR BRUSHING TO A FINISH OF SA 2 1/2 OF THE SWEDISH STANDARD SIS 05 59 00. METAL SPRAYING OF THE SURFACES WITH ZINC TO COMPLY WITH THE REQUIREMENTS OF BS 2569 FOR Zn 10. COATING OF THE ZINC SPRAYED SURFACES WITHIN 4 HOURS WITH A SEALER COMPATIBLE WITH THE ZINC AND SUBSEQUENT COAT OF PAINT. APPLICATION OF TWO COATS OF 75 MICRON DRY FILM THICKNESS OF POLYAMIDE EPOXY PAINT.

-WHEN SURFACES ARE TO BE EMBEDDED IN CONCRETE, THEY SHALL BE COATED AS ABOVE UP TO 30 mm FROM THE EDGES.

-TOLERANCES ACCORDING TO BS "MEDIUM"

WELDING CLASS: WB-1.



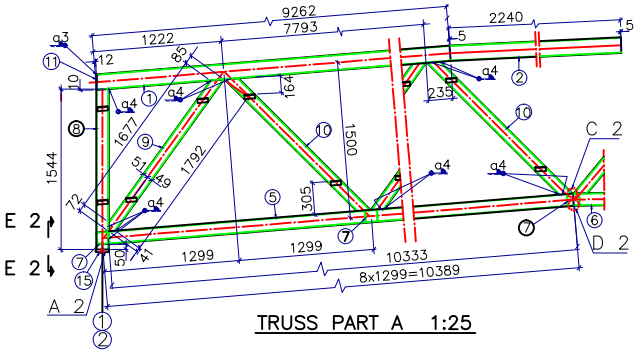
NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

REVISIONS

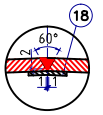
THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
ETHIOPIAN ROADS AUTHORITY
Post Office Box 1770 Addis Ababa Ethiopia
Cable Address Highways Addis Ababa
Telex 21180 Tel.No. 51-71-70/79

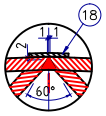
PEDESTRIAN STEEL TRUSS BRIDGE 28m. CLEAR SPAN

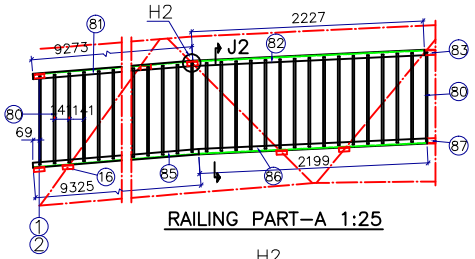
DRAWN	SISAY GETU	SCALE:	DRG. NO.
DESIGNED		AS SHOWN	P – 05
CHECKED	L. RAHM	DATE	
EDITED	S.JORSTEN	26/01/99	
APPROVED	B.JEBESSA		



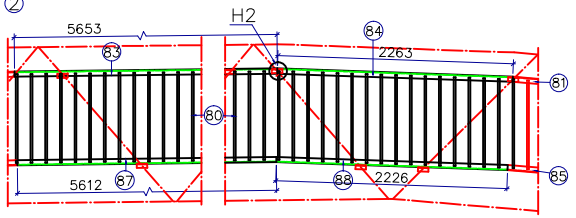
TRUSS PART A 1:25







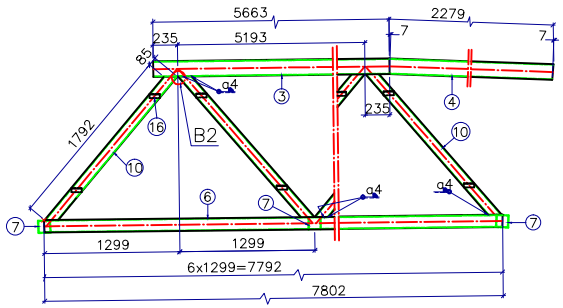
RAILING PART–A 1:25



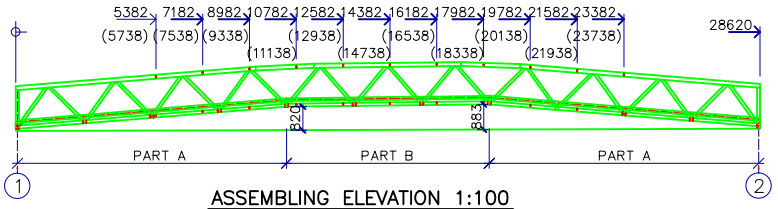
RAILING PART–B 1:25

ITEM	NO	STEEL	LENGTH	QUALITY	WEIGHT	NOTE
80	406	KKR 18mm.	854	S275	2	
81	4	L50x50x6	9273	"	41	
82	2	L 50x50x6	2227	"	10	
83	2	L 50x50x6	5653	"	25	
84	2	L 50x50x6	2263	"	10	
85	4	L 50x50x6	9325	"	42	
86	2	L 50x50x6	2199	"	10	
87	2	L 50x50x6	5612	"	25	
88	2	L 50x50x6	2226	"	10	
89	48	SCREW M12x35		8.8		
RAILINGS (2 SIDES)			TOTAL WEIGHT 1365 Kg.			

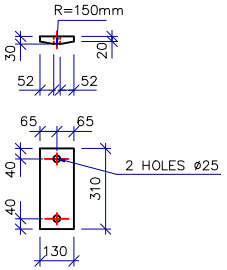
* LIST OF ITEMS



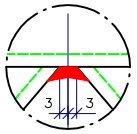
TRUSS PART B 1:25



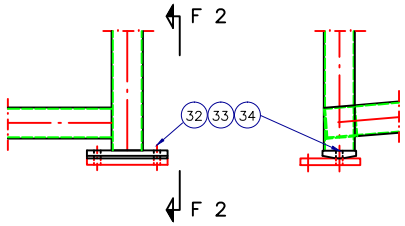
ASSEMBLING ELEVATION 1:100



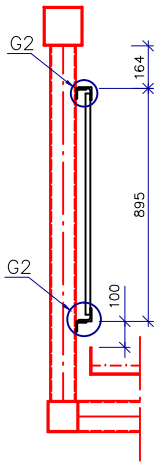
A 2 1:10
POS 15



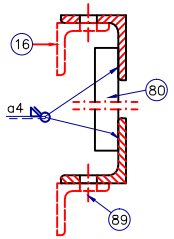
B 2 1:10



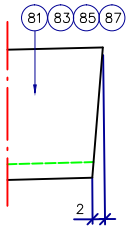
E 2 1:10 F 2 1:10



SECTION J2 1:10



G2 1:10



H2 1:10

GENERAL NOTES

DESIGN LOADS: THE BRIDGE IS DESIGNED ACCORDING TO THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL, FOR 4kN/m2

DESIGN SPECIFICATIONS: THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL AND EBCS NR4 STEEL DESIGN.

CONSTRUCTION: THE BRIDGE SHALL BE CONSTRUCTED ACCORDING TO THE PREVAILING VERSION OF THE ERA ROAD AND BRIDGE SPECIFICATIONS

REQUIREMENTS

SURFACE COATING:

–CORROSION PROTECTION: TO BE MADE BEFORE ASSEMBLING THE PARTS. PREPARATION OF THE SURFACES BY ABRASIVE BLASTING OR BRUSHING TO A FINISH OF SA 2 1/2 OF THE SWEDISH STANDARD SIS 05 59 00. METAL SPRAYING OF THE SURFACES WITH ZINC TO COMPLY WITH THE REQUIREMENTS OF BS 2569 FOR Zn 10. COATING OF THE ZINC SPRAYED SURFACES WITHIN 4 HOURS WITH A SEALER COMPATIBLE WITH THE ZINC AND SUBSEQUENT COAT OF PAINT. APPLICATION OF TWO COATS OF 75 MICRON DRY FILM THICKNESS OF POLYAMIDE EPOXY PAINT.

–WHEN SURFACES ARE TO BE EMBEDDED IN CONCRETE, THEY SHALL BE COATED AS ABOVE UP TO 30 mm FROM THE EDGES.

–TOLERANCES ACCORDING TO BS "MEDIUM"

WELDING CLASS: WB–1.

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

REVISIONS

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
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Post Office Box 1770 Addis Ababa Ethiopia
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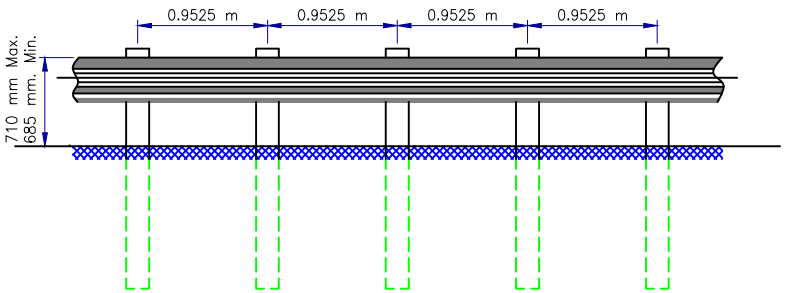
Telex 21180 Tel.No. 51–71–70/79

PEDESTRIAN BRIDGE TRUSS SPAN 28m: A, B AND RAILING DETAILS

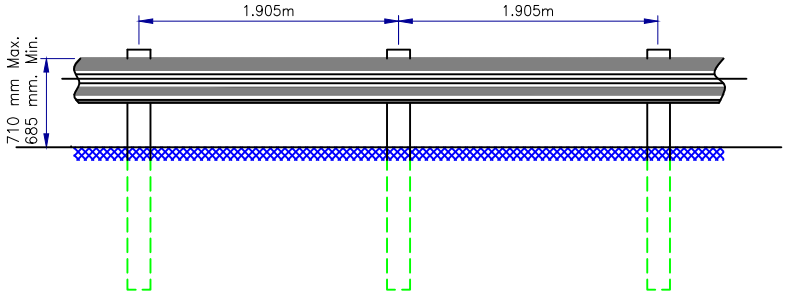
DRAWN	SISAY GETU	SCALE:	DRG. NO.
DESIGNED		AS SHOWN	P – 06
CHECKED	L. RAHM	DATE	
EDITED	S.JORSTEN	26/01/99	
APPROVED	B.JEBESSA		



GR – 2A

(0.9525m Post Spacing)

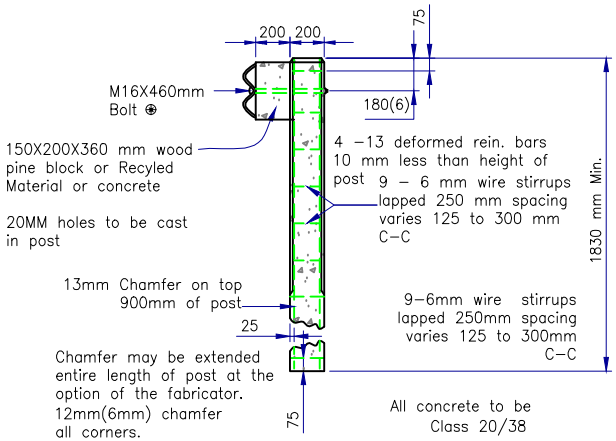
Blockout for concrete post to be cut to fit post shape to prevent blockout from rotating.



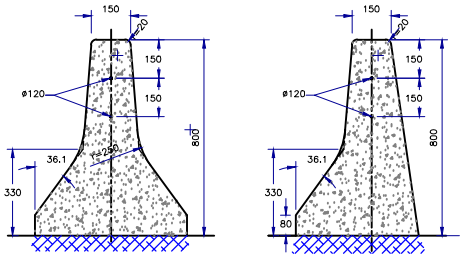
GR – 2

(1.905m Post Spacing)

Dimensions shown in parenthesis indicate acceptable tolerances.


200 200
75
M16X460mm Bolt ⊕
180(6)
150X200X360 mm wood pine block or Recyled Material or concrete
20MM holes to be cast in post
4 –13 deformed rein. bars 10 mm less than height of post
9 – 6 mm wire stirrups lapped 250 mm spacing varies 125 to 300 mm C–C
1830 mm Min.
13mm Chamfer on top 900mm of post
25
9–6mm wire stirrups lapped 250mm spacing varies 125 to 300mm C–C
Chamfer may be extended entire length of post at the option of the fabricator. 12mm(6mm) chamfer all corners.
75
All concrete to be Class 20/38

CONCRETE POST



CONCRETE GUARDRAILS

NOTES:

Guardrail locations shown on plans are approximate only and can be adjusted during construction if and as directed by the Engineer.
For details of Rail Element, Rail Splice joint, W Beam Back – up plate, and associated hardware see sheet no. R – 05.
Rail elements are furnished shop curved for radii between 1.5 m and 46.0 m.
All bolts, nuts, & washers are to be galvanized.
Standard washer to be used on last 15 m. of run – off end.
All guardrail components are paid for under the unit price for guard rail.
Concrete posts shown : timber posts or steel posts can alternatively be specified.

All dimensions are in mm, unless noted.

Timber Guardrails are not recommended.

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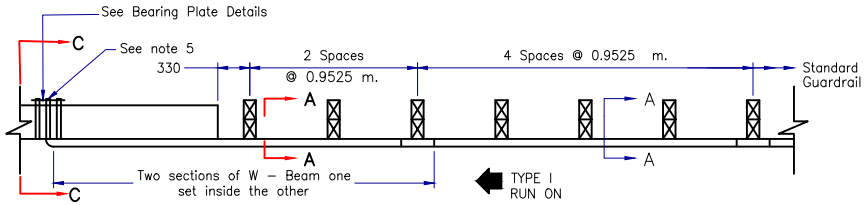
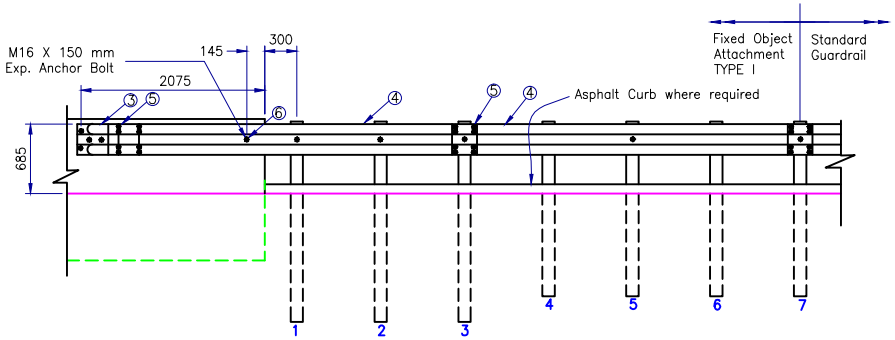
GUARDRAIL AND POST

DRAWN	SABELA GETACHEW	SCALE:	DRG. NO.
DESIGNED	JOHN ALLEN	AS SHOWN	R – 01
CHECKED	MICHAEL S. NYQUIST	DATE	
EDITED	S.JORSTEN	09/03/99	
APPROVED	B.JEBESSA		

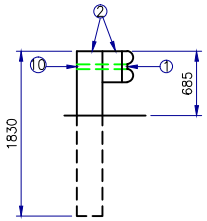


PLAN

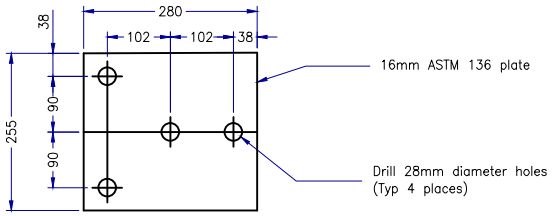


ELEVATION
RUN – ON ATTACHMENT

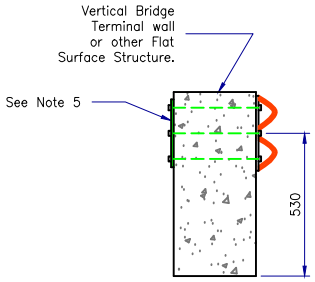
New Bridges – Attachments
–Run – on, 2 –GR FOA –1,Type I
–Run – off, 2 GR – FOA – 1,Type II
Existing bridge attachments as shown on plans.



SECTION A – A



BEARING PLATE

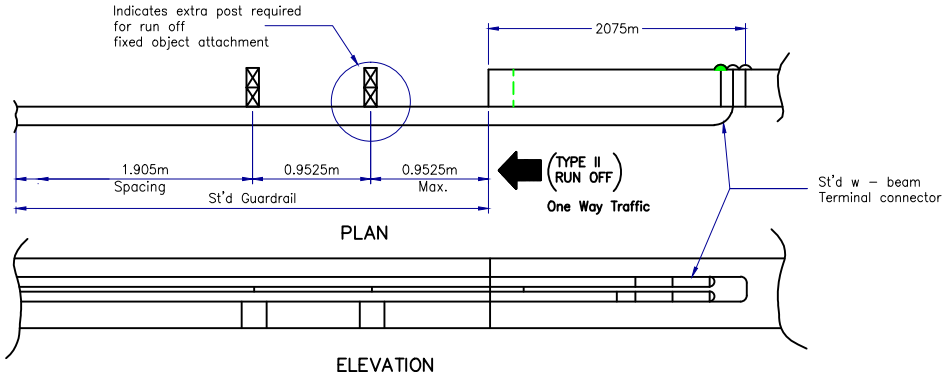


SECTION C – C

NOTES:

1. Fixed objects may consist of bridge rails, abutments, piers, piers walls, or other flat surfaced structures with a vertical face.
2. Bridge rail ends and bridge parapets must be of adequate strength to accept full impact loading
3. Guardrail components to be in accordance with Guard Rail Drawing Standards.
4. W – beam is not bolted to posts at posts 4 and 6: Bolts block directly to post.
5. Appropriate length M22 diameter ASTM A325M hex bolts must be used with thru drilled holes with a 16 mm bearing plate on the back side of the bridge parapet or Terminal wall.

Item	Material /Specifications/ Notes
①	M16 X 460 mm Guardrail bolt & Recessed nut
②	Standard 150 x 200 mm Wood post & block
③	Standard W – Beam terminal connector
④	Standard W – Beam rail
⑤	M16 X 50 Guardrail Bolt & Recessed Nut
⑥	Rectangular Plate Washer (See Standard R – 05)



PLAN

ELEVATION
RUN OFF ATTACHMENT

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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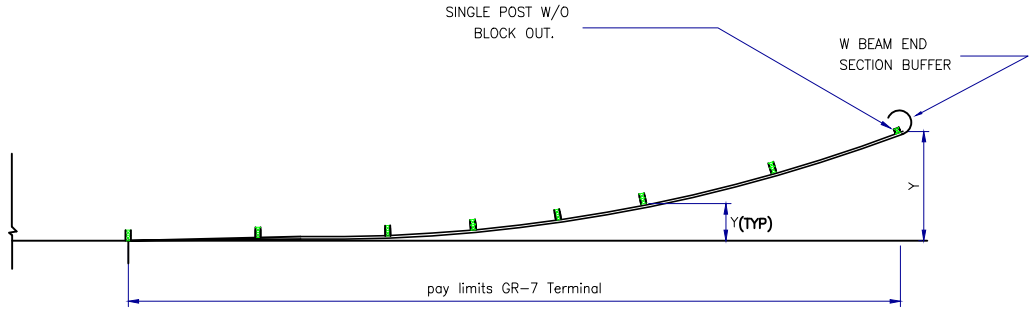
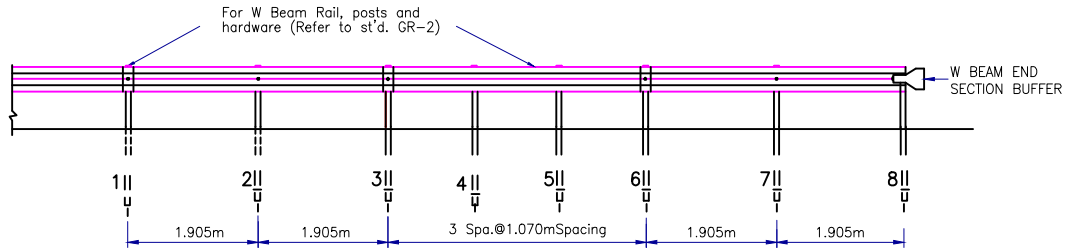
GUARDRAIL W BEAM – FIXED OBJECT ATTACHMENT

DRAWN	HELEN TADDESSE	SCALE:	DRG. NO.
DESIGNED	JOHN ALLEN	AS SHOWN	R – 02
CHECKED	MICHAEL S. NYQUIST	DATE	
EDITED	S.JORSTEN	09/03/99	
APPROVED	B.JEBESSA		



PLAN



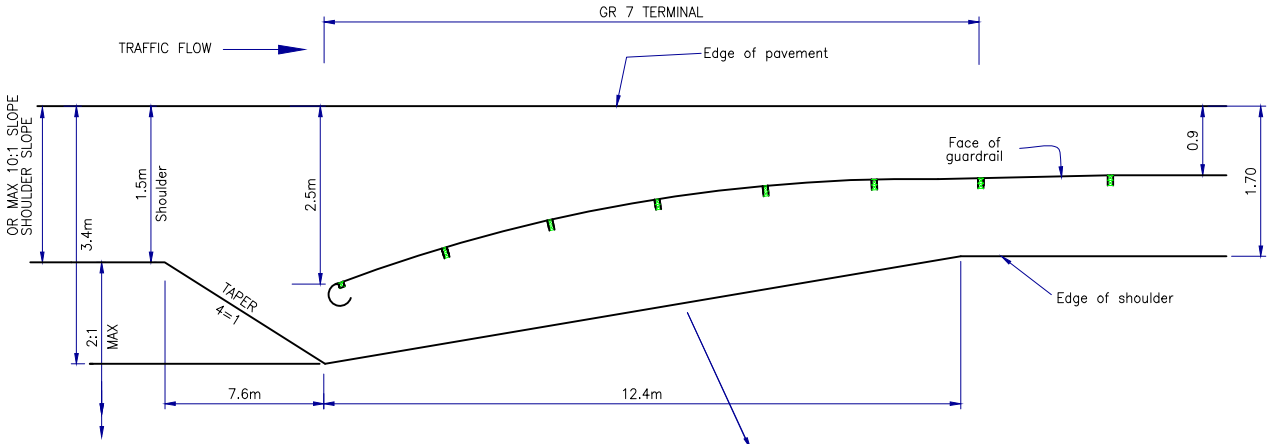
ELEVATION

GUARD RAIL TERMINAL GR7

GENERAL NOTES:

1. All components detailed hereon are to be galvanized in accordance with the specification
2. For details of W Beam Rail, method of attaching rail to posts, splices, and other dimensions not show hereon, see sheet No. R – 05
3. The guardrail and median barrier component depicted in AASHTO – AGC – ARTBA 'A Guide to Standardized Highway Barrier Hardware' may be substituted if interchangeable with the standards for guardrail (GR) and approved by the Engineer.
4. Posts 1–7 have standard blockouts.
5. No bolts through rail to posts 4&5.
6. The post offset dimensions are given to the center of the traffic face of the blockouts, except at the first post, where the dimension is to the center of the traffic face of the post. Offset points are to be located by chord measurements at the back of rail equal to the nominal post spacings shown. Posts are to be set approximately radial to the railing at each post location.

POST OFFSETS FROM TANGENT	
POST	Y(mm)
1	0
2	40
3	80
4	140
5	240
6	400
7	800
8	1600



GRADING DETAILS
@GR7 TERMINAL

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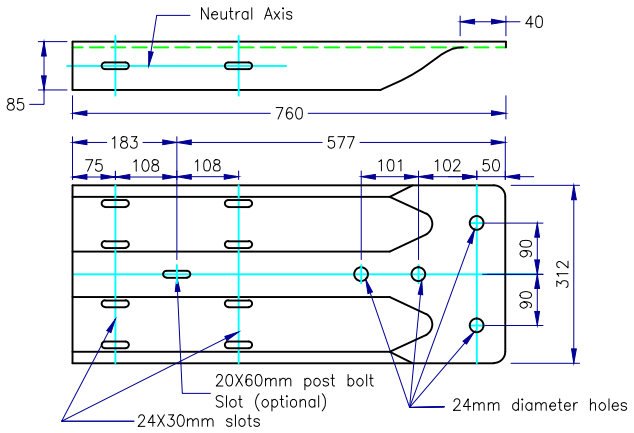
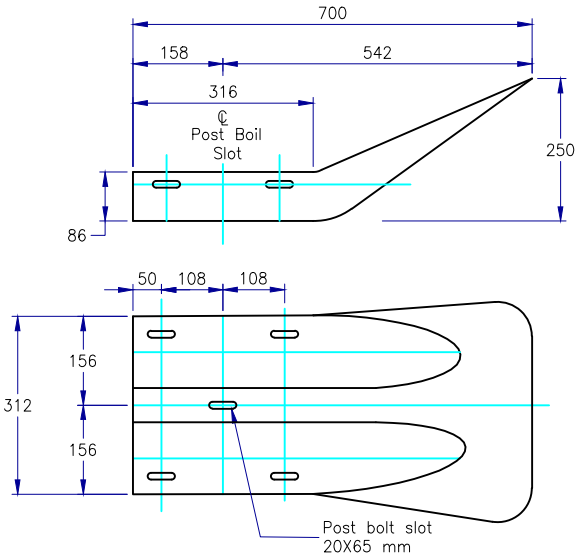
GUARDRAIL TERMINAL GR7

DRAWN	HELEN TADDESSE	SCALE:	DRG. NO.
DESIGNED	JOHN ALLEN	AS SHOWN	R – 03
CHECKED	MICHAEL S. NYQUIST	DATE	
EDITED	S.JORSTEN	09/03/99	
APPROVED	B.JEBESSA		



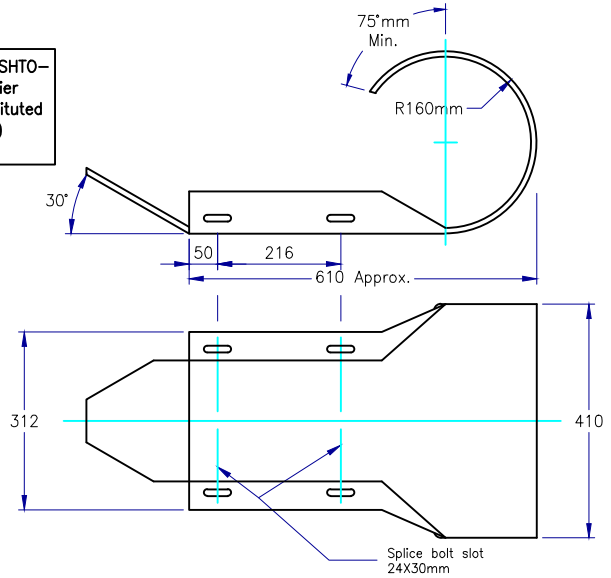
W BEAM TERMINAL CONNECTOR (MOD.)

Note:
Lap in direction of traffic at splice joint



W BEAM END SECTION (FLARED)

⊖The guardrail median barrier components depicted in AASHTO–AGC – A.R.T.B.A. "A Guide to Standardized Highway Barrier Hardware' Technical Bulletin Number 268b may be substituted if interchangeable with the standards for guardrail (GR) or median barrier (MB) and approved by the engineer.



W BEAM END SECTION (ROUNDED)

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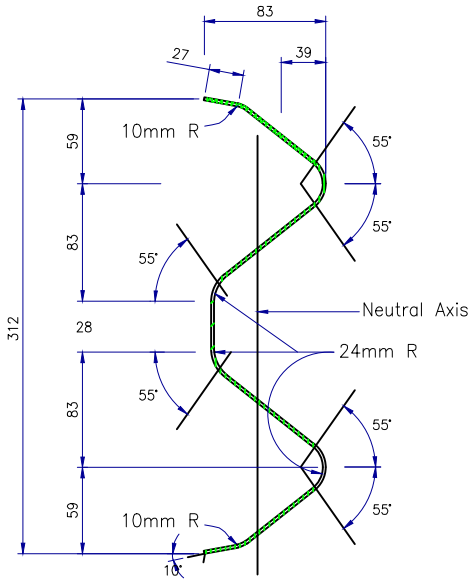
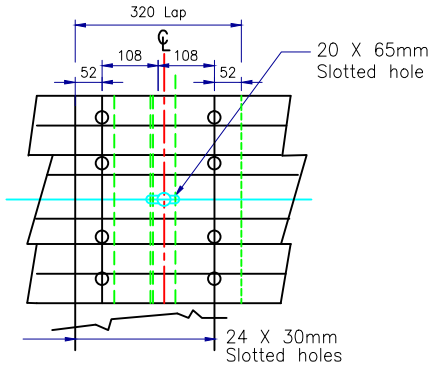
GUARDRAIL HARDWARE: W BEAM END SECTION

DRAWN	SABELA GETACHEW	SCALE:	DRG. NO.
DESIGNED	JOHN ALLEN	AS SHOWN	R – 04
CHECKED	MICHAEL S. NYQUIST	DATE	
EDITED	S.JORSTEN	09/03/99	
APPROVED	B.JEBESSA		

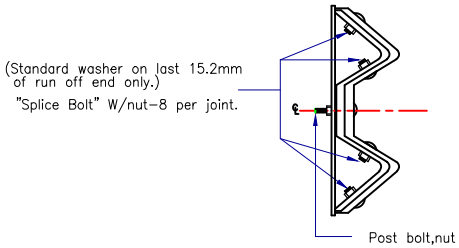


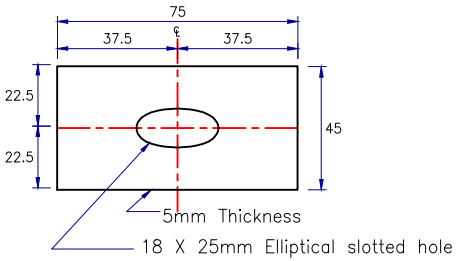
SECTION THRU RAIL ELEMENT AND
W BEAM BACK – UP PLATE



Lap in Direction
of Traffic

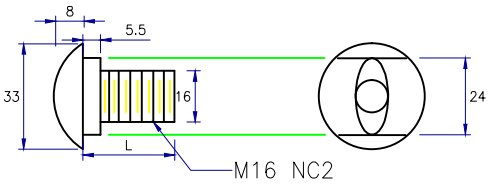
DETAIL OF SPLICE JOIN

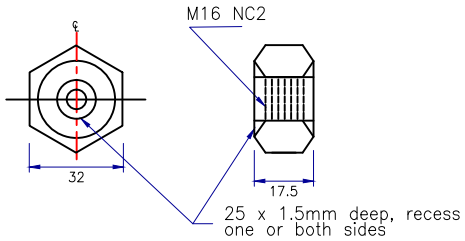




DETAIL OF STANDARD WASHER

(for GR–2 and 2A,–MB–3 and 3A)
To be used on last 15.2m of Run off ends only





L = 35mm for splice Bolt – full length threads
L = 50mm for steelpost Bolt – 38mm min. threads
L = 460mm for wood and concrete post Bolt – 63mm min. threads
L = 640mm for MB wood or Concrete post – 50mm minimum threads

DETAIL OF BUTTON HEAD BOLT AND RECESS NUT

Notes:
All hardware to be galvanized in accordance with the specifications.

The guardrail and median barrier components depicted in AASHTO–AGC–ARTBA("A Guide to Standardized Highway Barrier Hardware") may be substituted if interchangeable with the standards for guardrail (GR) or median Barrier (MB)and approved by the Engineer.

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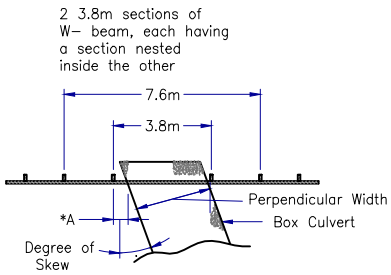
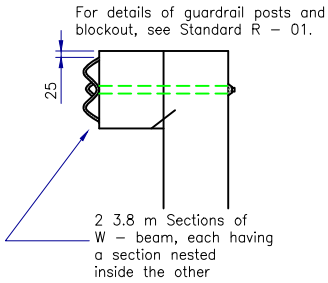
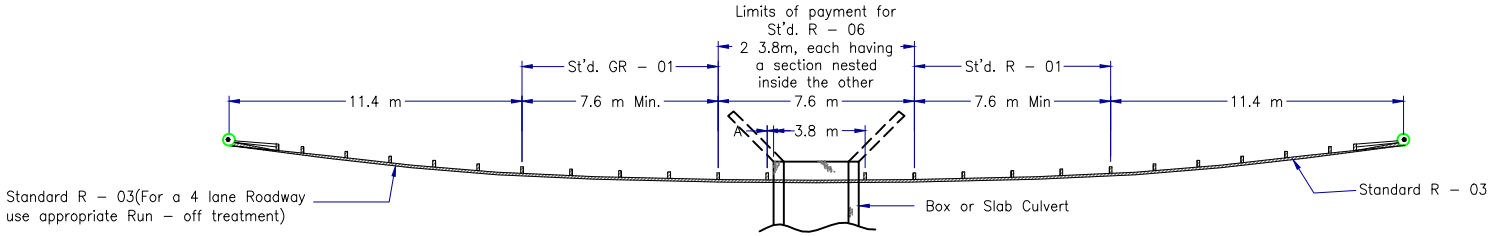
GUARDRAIL HARDWARE:
W BEAM

DRAWN	HELEN TADDESSE	SCALE:	DRG. NO.
DESIGNED	JOHN ALLEN	AS SHOWN	
CHECKED	MICHAEL S. NYQUIST	DATE	R – 05
EDITED	S.JORSTEN	09/03/99	
APPROVED	B.JEBESSA		

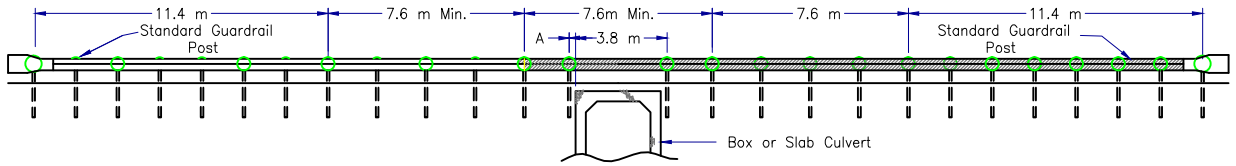


ONE POST OMITTED
TOP VIEW

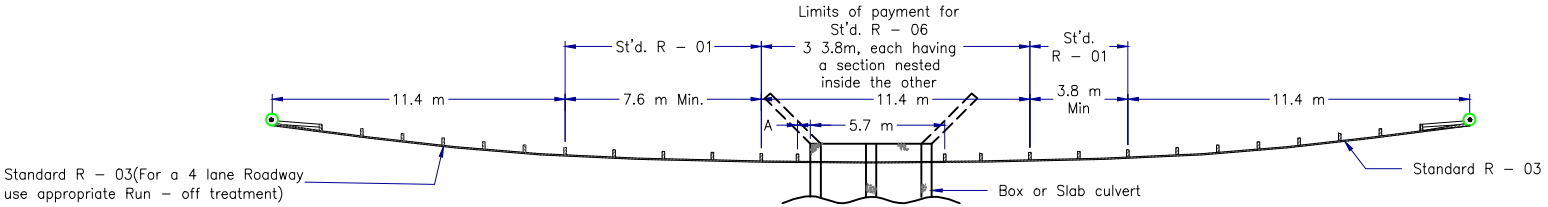

For details of guardrail posts and
blockout, see Standard R – 01.
25
2 3.8 m Sections of
W – beam, each having
a section nested
inside the other



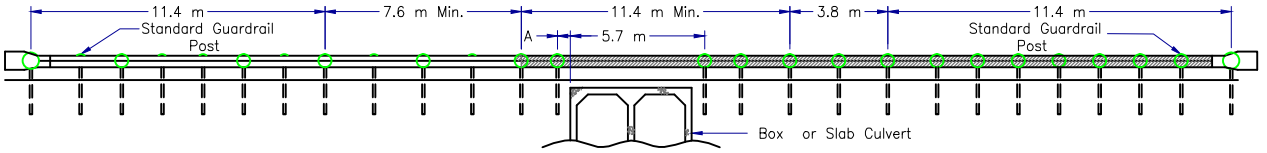
TOP VIEW



ELEVATION
TYPE I – ONE POST OMITTED



TOP VIEW



ELEVATION
TYPE II – TWO POSTS OMITTED

TABLE OF MAXIMUM ALLOWABLE STRUCTURE WIDTHS FOR THIS DESIGN

*"A" – the minimum allowable distance between closest point of post to structure.

Type I – One Post Omitted			Type II – Two Posts Omitted		
Skew	A* (m)	Maximum Perpendicular Width (meters)	Skew	A* (m)	Maximum Perpendicular Width (meters)
0°	.230	3.2	0°	.230	5.1
5°	.230	3.2	5°	.230	5.1
10°	.230	3.1	10°	.230	5.0
15°	.230	3.0	15°	.230	4.9
20°	.230	2.9	20°	.230	4.7
25°	.230	2.8	25°	.230	4.5
30°	.230	2.7	30°	.230	4.3
35°	.230	2.5	35°	.230	4.0
40°	.230	2.4	40°	.230	3.8
45°	.230	2.1	45°	.230	3.5

NOTES: This sheet is applicable when guardrail is required and the depth of fill above the top slab of the box culverts is less than 1090 mm.
Guardrail installation to be as specified in the prevailing version of the ERA Standard Specifications.
Components and Guardrail post spacing to be in accordance with standard R–01 trough R–04 details.

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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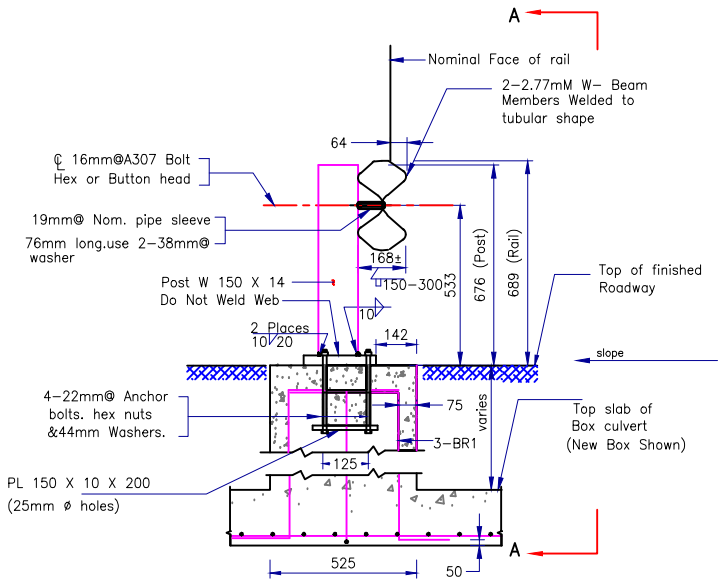
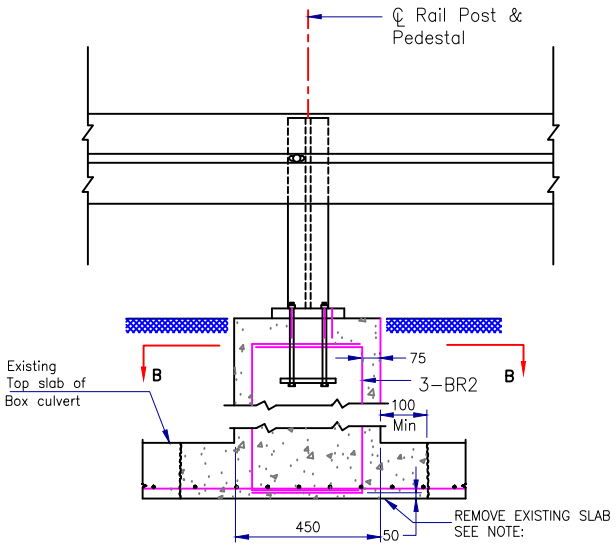
GUARDRAIL AT LOW FILL CULVERTS

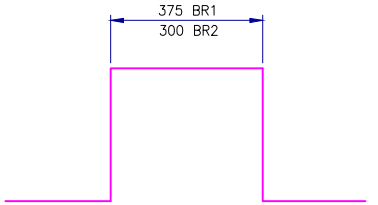
DRAWN	SABELA GETACHEW	SCALE:	DRG. NO.
DESIGNED	JOHN ALLEN	AS SHOWN	R – 06
CHECKED	MICHAEL S. NYQUIST	DATE	
EDITED	S.JORSTEN	10/03/99	
APPROVED	B.JEBESSA		



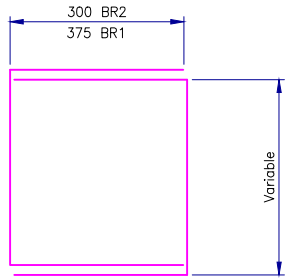
PART TRANSVERSE SECTION



SECTION A–A

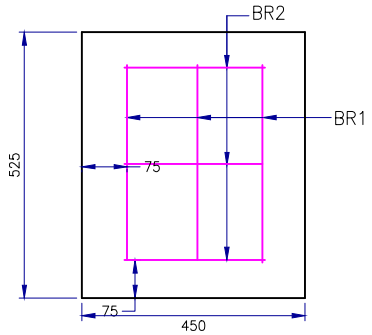


NEW BOX – BR1

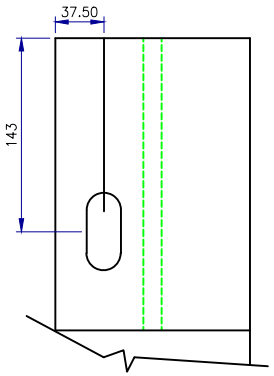


EXISTING BOX – BR2

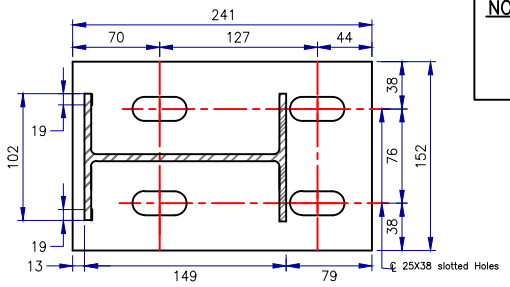
BR SERIES SHAPES



SECTION B–B
(Anchor Bolts Not Shown)



19mm X 38mm SLOTTED HOLE IN POST



16mm BASE PLATE
(25 x 38 Slotted Holes)

NOTE:
Remove portions of existing slab carefully exposing reinforcing. Lap in BR Bars

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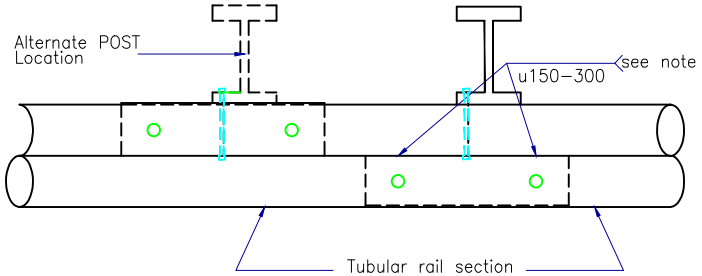
C					
B					
A					

REVISIONS

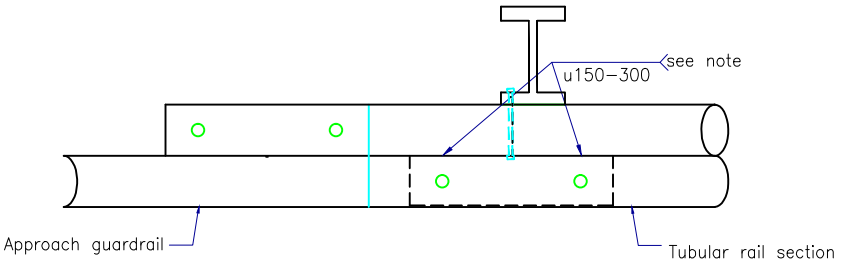
THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
ETHIOPIAN ROADS AUTHORITY
Post Office Box 1770 Addis Ababa Ethiopia
Cable Address Highways Addis Ababa
Telex 21180 Tel.No. 51–71–70/79

TUBULAR GUARDRAIL MOUNTED ON CULVERT
SHEET 1/2

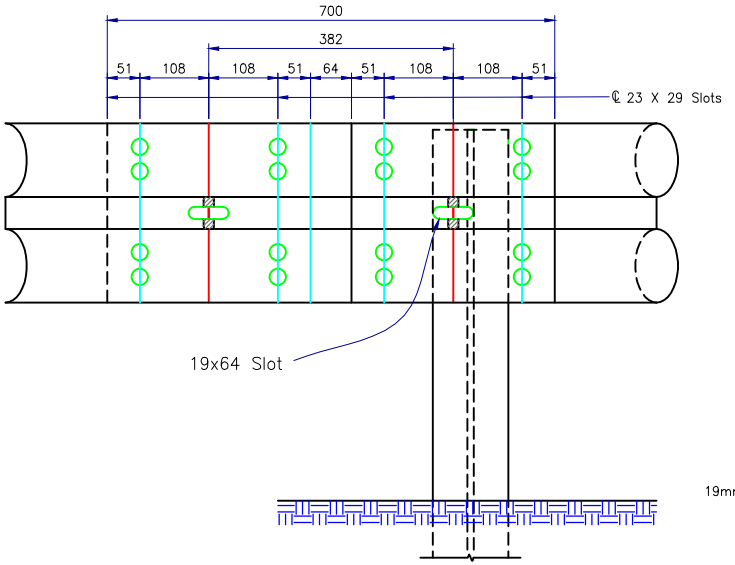
DRAWN	HELEN TADDESSE	SCALE:	DRG. NO.
DESIGNED	JOHN ALLEN	AS SHOWN	R – 07
CHECKED	MICHAEL S. NYQYIST	DATE	
EDITED	S.JORSTEN	10/03/99	
APPROVED	B.JEBESSA		



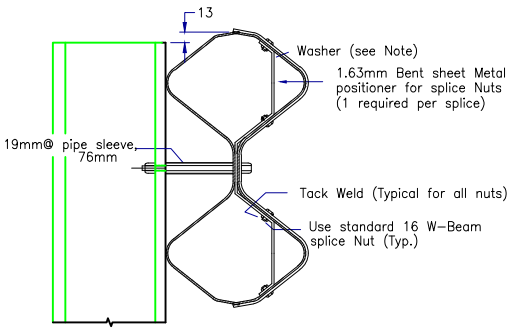
PLAN



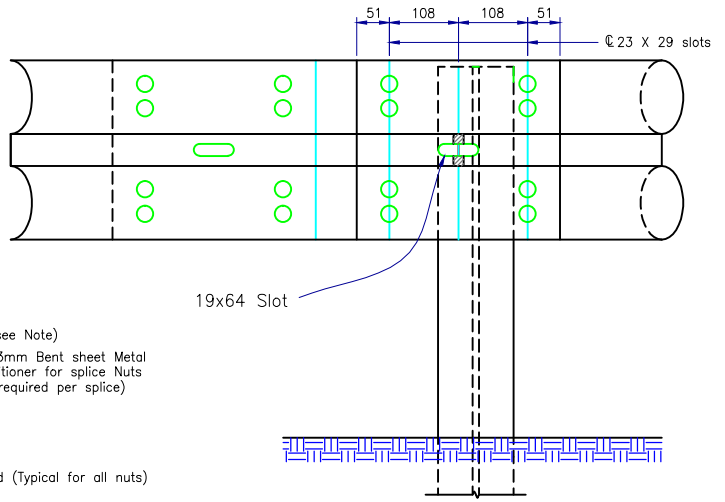
PLAN



TUBULAR RAIL SPLICE


13
Washer (see Note)
1.63mm Bent sheet Metal positioner for splice Nuts (1 required per splice)
19mm@ pipe sleeve, 76mm
Tack Weld (Typical for all nuts)
Use standard 16 W-Beam splice Nut (Typ.)

SPLICE DETAIL



GUARDRAIL– TUBULAR RAIL SPLICE

Note:

8–16mm splice nuts shall be tack welded to a bent sheet metal position as shown. Other suitable positioning methods or devices may be substituted. The completed splice shall have 8 bolts (16 bolts if a Tubular Rail splice). Each bolt will include a 44X76X5 plate washer or a 51 mm diameter washer.

Note:

Tubular W–Beam Rail member is to be fabricated from standard 7620mm Nominal W–Beam section. Top and bottom seams shall be butt welded 150mm at 300mm spacing. Continuous seam welding is also acceptable. Welds shall be chipped and cleaned and the complete 7620mm tubular member shall be galvanized after fabrication. For tubular rail splice, additional post mounting slots are to be made in each member 381mm from the standard slots at 1905mm centers.

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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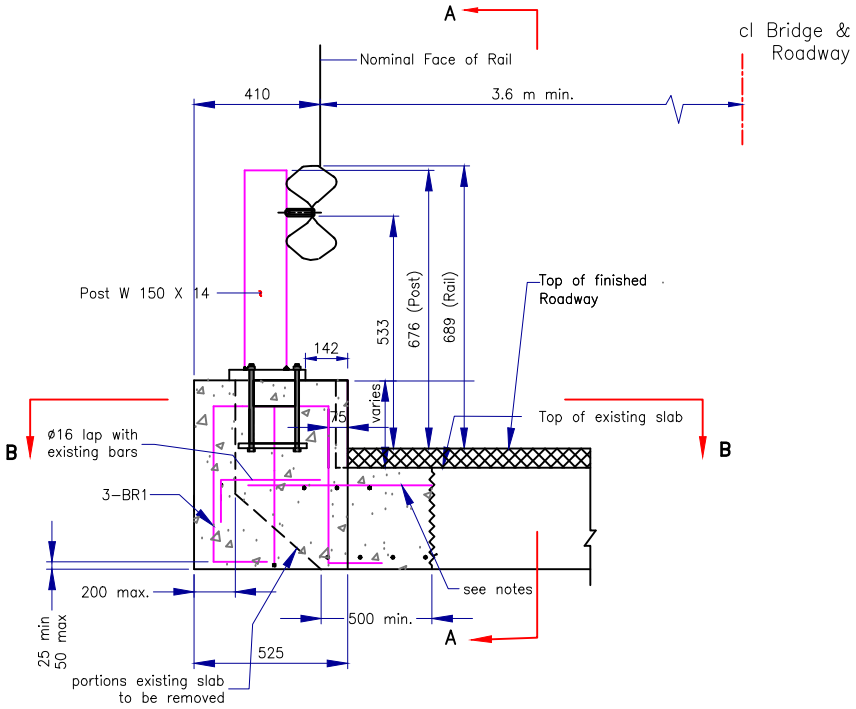
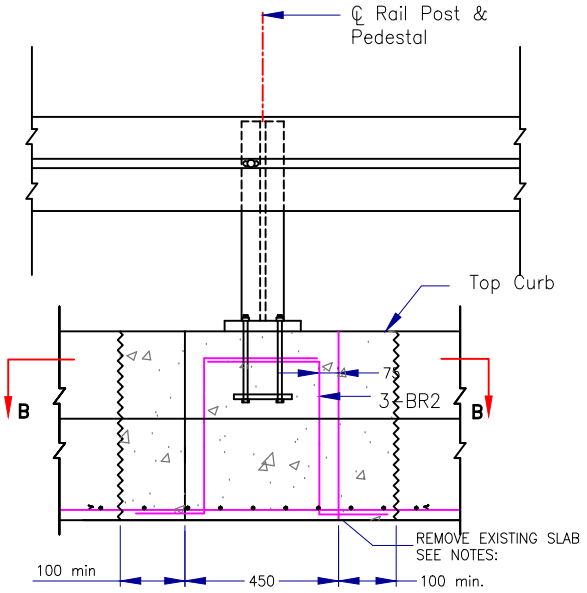
TUBULAR GUARDRAIL MOUNTED ON CULVERT
SHEET 2/2

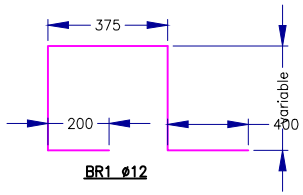
DRAWN	HELEN TADDESSE	SCALE:	DRG. NO.
DESIGNED	JOHN ALLEN	AS SHOWN	R – 08
CHECKED	MICHEAL S. NYQUIST	DATE	
EDITED	S.JORSTEN	10/03/99	
APPROVED	B.JEBESSA		

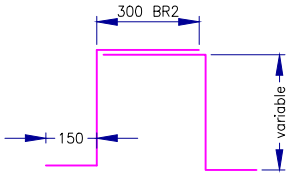


PART TRANSVERSE SECTION



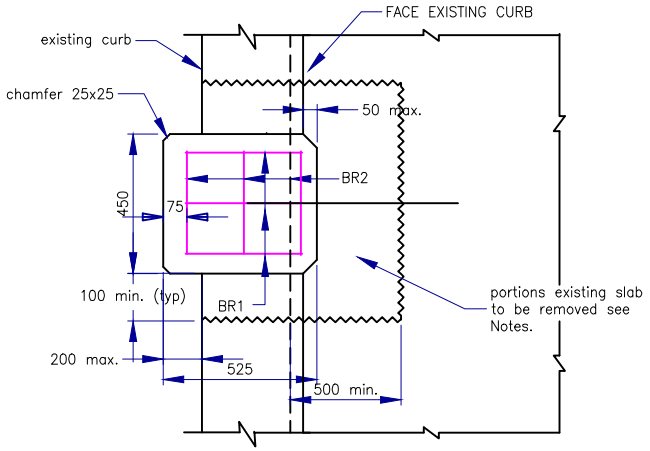
SECTION A–A





BR2 ø12

BR SERIES SHAPES



SECTION B–B **(PART PLAN)**
(Anchor Bolts Not Shown)

NOTES:

Remove portions of existing slab carefully exposing reinforcing and lap in BR Bars.

For bars & details not shown see sheets R – 07 & R – 08

All dimensions are in mm unless otherwise noted.

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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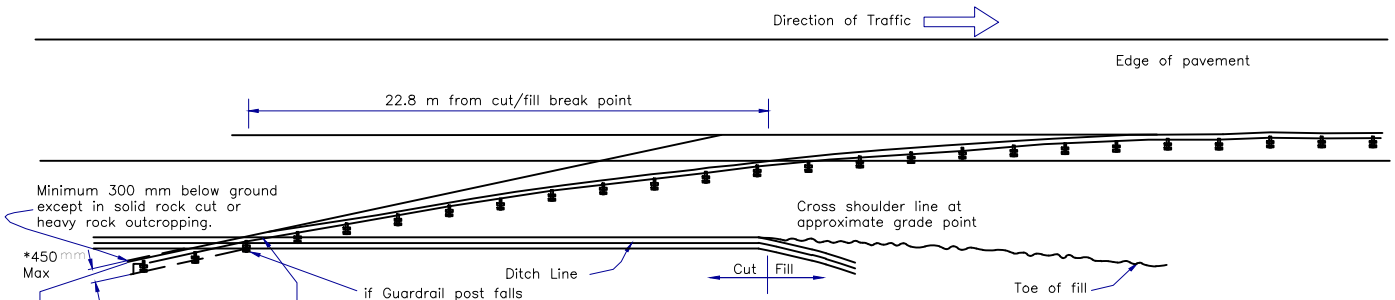
TUBULAR GUARDRAIL MOUNTED ON BRIDGE SLAB

DRAWN	HELEN TADDESSE	SCALE:	DRG. NO.
DESIGNED	JOHN ALLEN	AS SHOWN	R – 09
CHECKED	MICHAEL S. NYQUIST	DATE	
EDITED	S.JORSTEN	10/03/99	
APPROVED	B.JEBESSA		

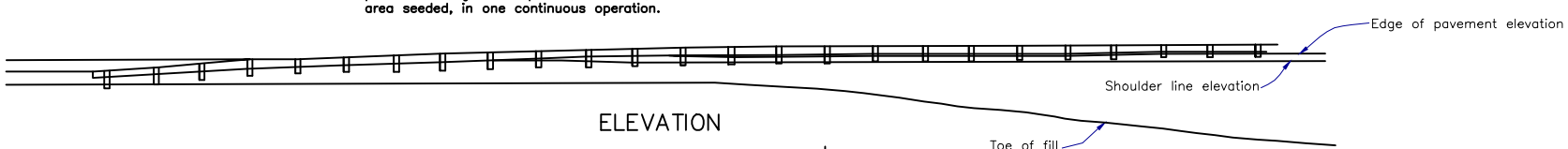

Direction of Traffic
Edge of pavement
22.8 m from cut/fill break point
Minimum 300 mm below ground except in solid rock cut or heavy rock outcropping.
*450 mm Max
Guardrail is to be extended a minimum of 2–1.9 m spans beyond ditch line. Guardrail is to terminate a minimum of 300 mm below ground elevation of the back slope except in areas of heavy rock outcropping where minimum depth may be 150 mm.
If Guardrail post falls with the limits of the paved ditch, see detail below.
Ditch Line
Cut
Fill
Cross shoulder line at approximate grade point
Toe of fill

PLAN VIEW

*** A trench no greter than 450 mm in width is to be excavated into the cut slope to provide for the guardrail posts and beam. The contractor is to arrange his work sequence to provide that each GR–6 installation is to be excavated, posts driven, guardrail placed, backfilled, and the disturbed area seeded, in one continuous operation.**

FLARE RATES			
DESIGN SPEED km\h	INSIDE SHY LINE		BEYOND SHY LINE
	SHY LINE m	FLARE RATE	FLARE RATE
110	2.8	30:1	15:1 **
100	2.4	26:1	14:1 **
80	2.0	21:1	11:1 **
60	1.4	16:1	8:1 **
50	1.1	13:1	7:1 **

****suggested maximum flare rate for semi–rigid barrier systems.**



ELEVATION

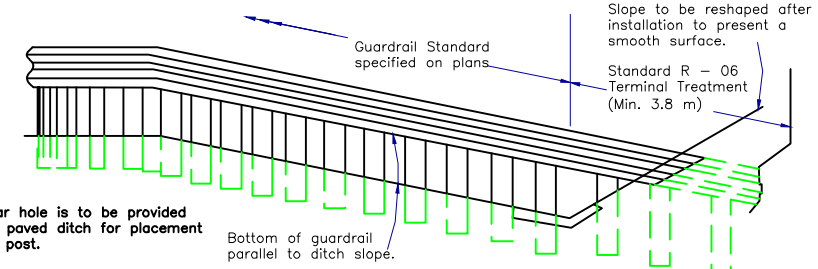
NOTES
The offset block may be eliminated for any post which will be completely below grade. The alignment of such posts must be field adjusted.

Alternate steel post and offset brackets may be substituted for designs shown hereon.

2 Post must be buried a minimum of 300 mm below ground elevation of the back slope except in areas of heavy rock outcropping where minimum depth may be 150 mm.

Standard GR–6 terminal treatment may be used at the run–on end of divided highways (left and right of traffic) and at the run–on and run–off ends on undivided highways.

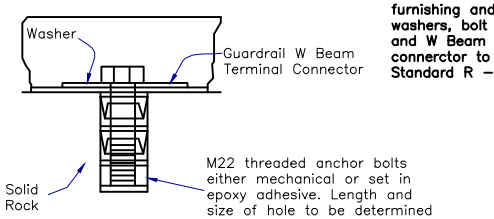
Height of guardrail to be maintained at 685 mm Min., 710 mm Max. from the ground line to the top of rail for the entire length to the ditch line.


Guardrail Standard specified on plans
Slope to be reshaped after installation to present a smooth surface.
Standard R – 06 Terminal Treatment (Min. 3.8 m)
Bottom of guardrail parallel to ditch slope.
All posts to be 1820 min, in length except W150x13x760 end post may be used in areas of heavy rock outcropping.

A rectangular hole is to be provided through the paved ditch for placement of guardrail post.

END VIEW

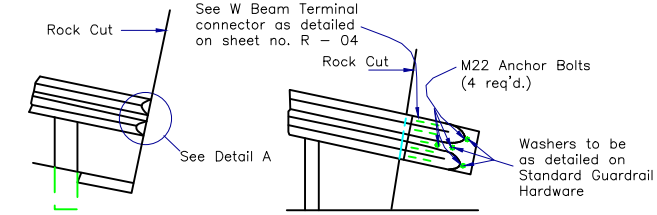
NORMAL INSTALLATION


Washer
Guardrail W Beam Terminal Connector
Solid Rock
M22 threaded anchor bolts either mechanical or set in epoxy adhesive. Length and size of hole to be determined by manufacturers recommendations.

Cost of drilling holes and furnishing and placing bolts, washers, bolt caulking anchors, and W Beam Terminal connerctor to be included in Standard R – 10.

DETAIL A

Note: Unless Otherwise noted all dimensions on this sheet are in millimeters.


Rock Cut
See W Beam Terminal connector as detailed on sheet no. R – 04
See Detail A
Rock Cut
M22 Anchor Bolts (4 req'd.)
Washers to be as detailed on Standard Guardrail Hardware

END VIEW

END ELEVATION

SOLID ROCK CUT INSTALLATION

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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B					
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GUARDRAIL, W BEAM : BURIED END TERMINAL TREATMENT

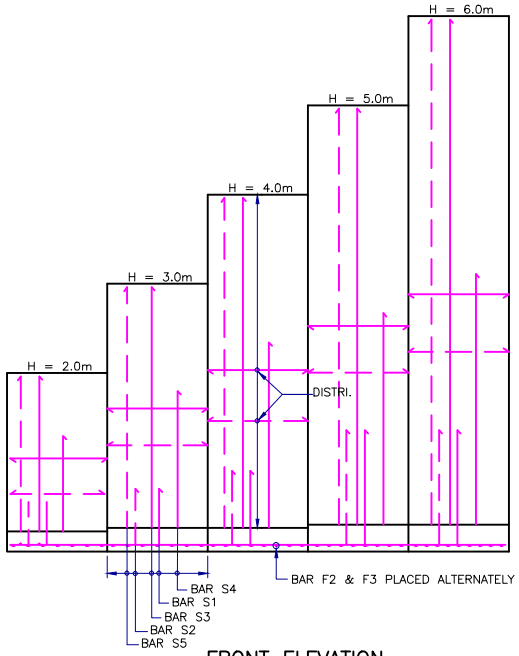
DRAWN	RAHEL LEMMA	SCALE:	DRG. NO.
DESIGNED	JOHN ALLEN	AS SHOWN	R – 10
CHECKED	MICHAEL S. NYQUIST	DATE	
EDITED	S.JORSTEN	13/07/99	
APPROVED	B.JEBESSA		

NOTE

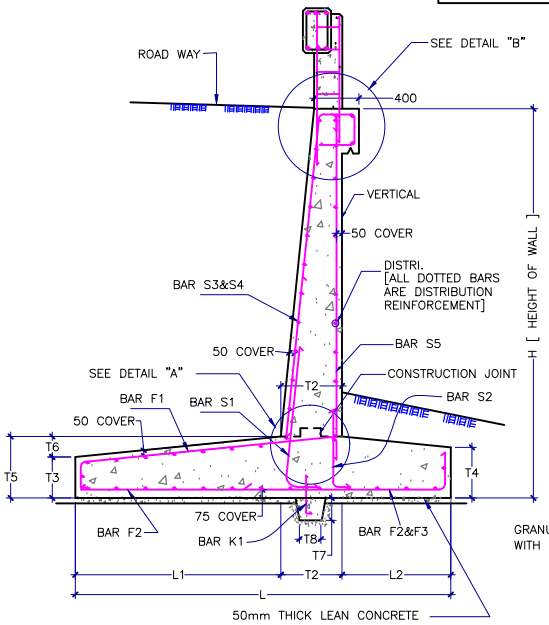
FOR THE POST AND RAILING DETAILS REFER TO ERA STD DRAWING NO. GR-01 THE POST AND RAILING DETAILS SHOWN MAY BE MODIFIED AS PER THE TRAFFIC CONDITION.

Table of Dimensions of the wall (m), reinforcement steel size, spacing (mm) and quantities per linear meter of wall

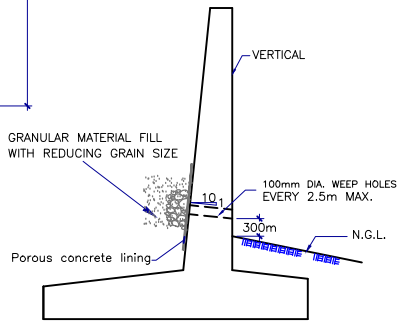
H	2.00		3.00		4.00		5.00		6.00	
T1	0.25		0.25		0.25		0.25		0.25	
T2	0.25		0.30		0.35		0.40		0.45	
T3	0.20		0.20		0.21		0.22		0.30	
T4	0.21		0.24		0.28		0.32		0.40	
T5	0.25		0.30		0.35		0.40		0.50	
T6	0.05		0.10		0.14		0.18		0.21	
T7	–		–		–		–		0.20	
T8	–		–		–		–		0.25	
L1	0.80		1.20		1.40		1.80		2.05	
L2	0.45		0.60		0.75		1.80		1.00	
L	1.50		2.10		2.50		3.00		3.50	
H*	1.07		1.57		2.08		2.37		2.81	
	ø	Spacing	ø	Spacing	ø	Spacing	ø	Spacing	ø	Spacing
Bar S1	12	180	16	190	20	210	20	140	24	150
Bar S2	10	250	10	270	10	300	10	320	10	280
Bar S3	12	360	16	380	20	420	20	280	24	300
Bar S4	12	360	16	380	20	420	20	280	24	300
Bar S5	10	250	10	270	10	300	10	320	10	280
Bar F1	10	140	12	140	16	170	20	200	20	170
Bar F2	10	440	10	440	12	360	12	320	16	420
Bar F3	10	440	10	440	12	360	12	320	16	420
Bar K1	–	–	–	–	–	–	–	–	10	450
Distr. bar	10	250	10	270	10	300	10	320	10	280
Concrete quantity [cu.m/m]	0.78		1.29		1.84		2.50		3.46	
Reinfor. quantity [kg/m]	43.10		74.50		114.00		172.90		265.40	



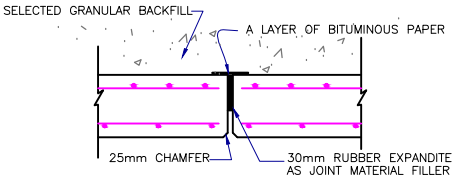
FRONT ELEVATION



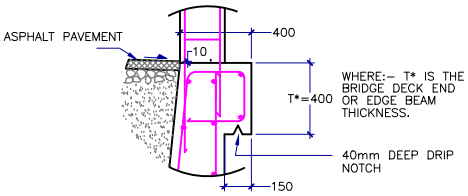
TYPICAL SECTION



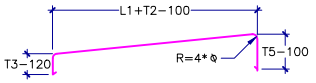
TYPICAL SECTION SHOWING DETAILS



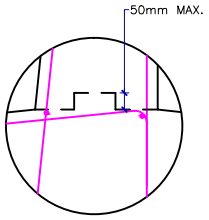
EXPANSION JOINT HORIZONTAL DETAIL



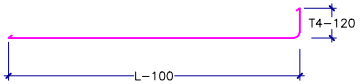
DETAIL "B"



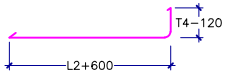
BAR F1



DETAIL "A"



BAR F2



BAR F3

BAR S1 BAR S3 BAR S4 BAR S2 BAR S5

	HEIGHT OF WALL [m]				
	2.0	3.0	4.0	5.0	6.0
a [mm]	480	640	890	940	1460
b [mm]	430	480	530	580	680

NOTE

- THE MINIMUM BEND RADIUS OF BARS IS 4*BAR DIAMETER.
- EXPANSION JOINTS SHALL BE PROVIDED EVERY 15m INTERVAL.
- THE BACKFILL MATERIAL SHALL BE SELECTED GRANULAR MATERIAL.
- THE MINIMUM ALLOWABLE BEARING CAPACITY OF THE FOUNDATION MATERIAL SHALL BE 150 & 200 kN/m FOR WALL HEIGHTS LESS THAN 3m AND 3 TO 6m, RESPECTIVELY.
- DURING CASTING OF CONCRETE, IF CONTINUOUS POURING OF CONCRETE IS NOT POSSIBLE, CONSTRUCTION JOINTS SHALL EITHER BE VERTICAL OR HORIZONTAL.
- IF THE THICKNESSES T7 & T8 ARE NOT GIVEN, NO SHEAR KEY IS REQUIRED.
- FOR SMALLER HEIGHTS OF H*, IT IS POSSIBLE TO START BAR S4 FROM BOTTOM OF FOOTING WITH BEND "a" AS SHOWN FOR BAR S1 LEAVING ONLY HALF OF THE No. OF BAR-S1 AS STARTER FOR BAR-S3.

GENERAL NOTES

MANUALS USED-THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL

LOADINGS USED:- HL-93=HS20-44 + LANE LOAD ACCORDING TO CHAPTER 3 OF THE ABOVE SPECIFICATIONS.

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED.

MATERIAL PROPERTIES

CONCRETE:- THE MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS SHALL BE 20MPa (GRADE 20).

REINFORCEMENT STEEL:- THE MINIMUM YIELD STRENGTH OF DEFORMED BARS SHALL BE 500 MPA IN ACCORDANCE WITH THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATIONS

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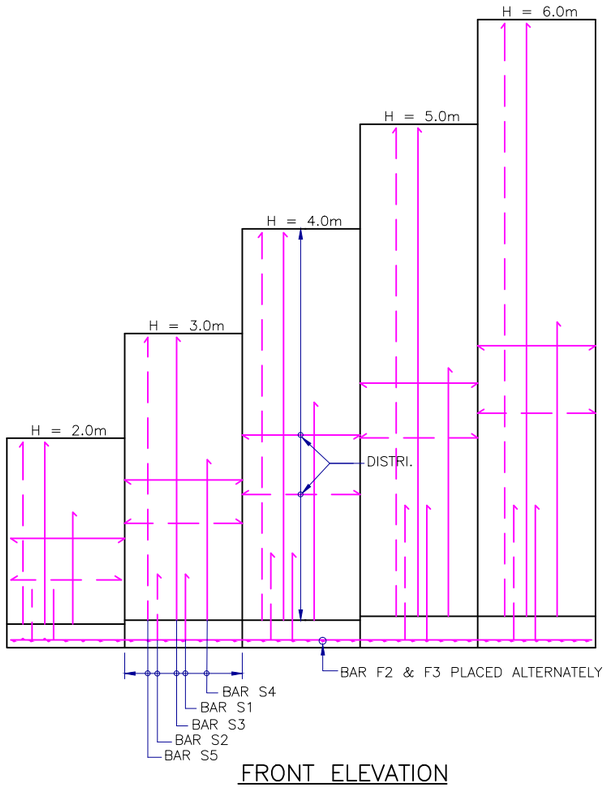
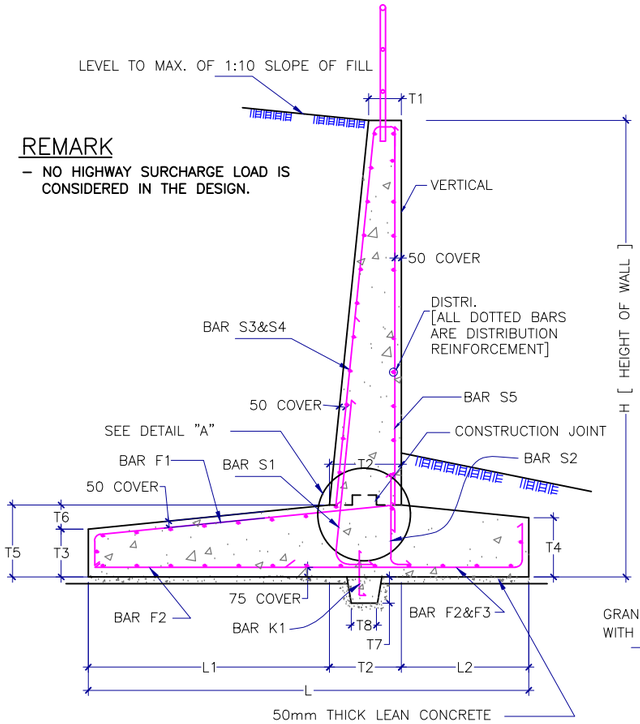
Cable Address Highways Addis Ababa
Telex 21180 Tel.No. 51-71-70/79

RETAINING WALL, RC CANTILEVER 2-6m. HIGH WITH ROADWAY ON TOP

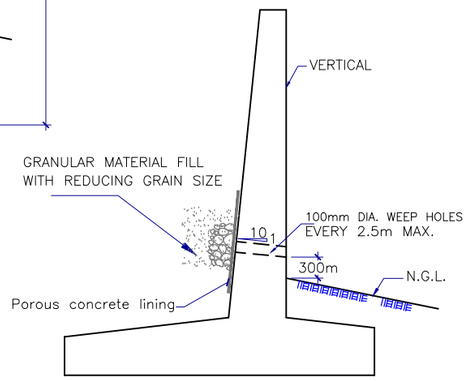
DRAWN	HENOK A.	SCALE:	DRG. NO.
DESIGNED	HENOK A.	AS SHOWN	
CHECKED	L. RAHM	DATE	W - 01
EDITED	S.WORSTEN	28/03/98	
APPROVED	B.JEBESSA		



FRONT ELEVATION



TYPICAL SECTION



TYPICAL SECTION SHOWING DETAILS

REMARK

– NO HIGHWAY SURCHARGE LOAD IS CONSIDERED IN THE DESIGN.

NOTE

THE POST AND RAILING DETAILS SHOWN MAY BE MODIFIED.

Table of Dimensions of the wall (m), reinforcement steel size, spacing (mm) and quantities per linear meter of wall

H	2.00		3.00		4.00		5.00		6.00	
T1	0.20		0.20		0.20		0.20		0.20	
T2	0.25		0.25		0.30		0.35		0.40	
T3	0.21		0.22		0.20		0.20		0.22	
T4	0.21		0.25		0.24		0.22		0.30	
T5	0.25		0.30		0.30		0.30		0.40	
T6	0.05		0.09		0.10		0.10		0.18	
T7	–		–		–		–		0.20	
T8	–		–		–		–		0.25	
L1	0.45		0.85		1.25		1.55		1.80	
L2	0.40		0.50		0.65		0.80		1.00	
L	1.10		1.60		2.20		2.70		3.20	
H*	0.67		0.72		1.12		1.43		1.59	
	ø	Spacing	ø	Spacing	ø	Spacing	ø	Spacing	ø	Spacing
Bar S1	10	180	12	180	16	180	20	180	24	170
Bar S2	10	220	10	220	10	250	10	270	10	300
Bar S3	10	360	12	360	16	360	20	360	24	340
Bar S4	10	360	12	360	16	360	20	360	24	340
Bar S5	10	220	10	220	10	250	10	270	10	300
Bar F1	10	450	12	280	12	140	16	130	20	190
Bar F2	10	440	10	440	10	380	12	280	16	420
Bar F3	10	440	10	440	10	380	12	280	16	420
Bar K1	–	–	–	–	–	–	–	–	10	450
Distr. bar	10	220	10	220	10	250	10	270	10	300
Concrete quantity [cu.m/m]	0.65		1.04		1.50		1.99		2.80	
Reinfor. quantity [kg/m]	36.70		57.90		89.40		146.70		217.10	

NOTE

– THE MINIMUM BEND RADIUS OF BARS IS 4*BAR DIAMETER.
– EXPANSION JOINTS SHALL BE PROVIDED EVERY 15m INTERVAL.
– THE BACKFILL MATERIAL SHALL BE SELECTED GRANULAR MATERIAL.
– THE MINIMUM ALLOWABLE BEARING CAPACITY OF THE FOUNDATION MATERIAL SHALL BE 150 & 200 kN/m FOR WALL HEIGHTS LESS THAN 3m AND 3 TO 6m, RESPECTIVELY.
– DURING CASTING OF CONCRETE, IF CONTINUOUS POURING OF CONCRETE IS NOT POSSIBLE, CONSTRUCTION JOINTS SHALL EITHER BE VERTICAL OR HORIZONTAL.
– IF THE THICKNESSES T7 & T8 ARE NOT GIVEN, NO SHEAR KEY IS REQUIRED.
– FOR SMALLER HEIGHTS OF H*, IT IS POSSIBLE TO START BAR S4 FROM BOTTOM OF FOOTING WITH BEND "a" AS SHOWN FOR BAR S1 LEAVING ONLY HALF OF THE No. OF BAR–S1 AS STARTER FOR BAR–S3.

GENERAL NOTES

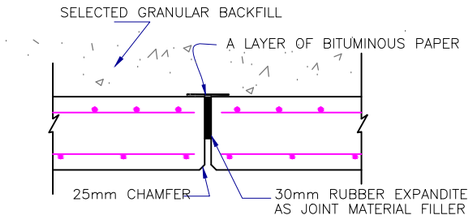
MANUALS USED–THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL

LOADINGS USED:– HL–93=HS20–44 + LANE LOAD ACCORDING TO CHAPTER 3 OF THE ABOVE SPECIFICATIONS.

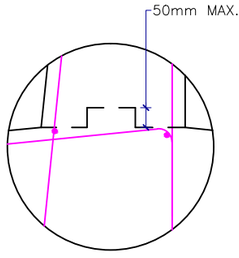
ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED.

MATERIAL PROPERTIES

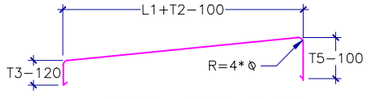
CONCRETE:– THE MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS SHALL BE 20MPa (GRADE 20).
REINFORCEMENT STEEL:– THE MINIMUM YIELD STRENGTH OF DEFORMED BARS SHALL BE 500 MPA IN ACCORDANCE WITH THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATIONS



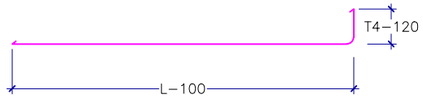
EXPANSION JOINT HORIZONTAL DETAIL



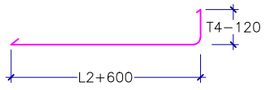
DETAIL ''A"



BAR F1

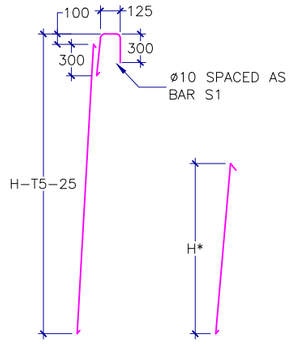


BAR F2



BAR F3

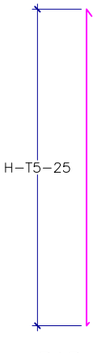
BAR S1



BAR S3

BAR S4

BAR S2



BAR S5

	HEIGHT OF WALL [m]				
	2.0	3.0	4.0	5.0	6.0
a [mm]	430	530	640	840	1360
b [mm]	430	480	480	480	580

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

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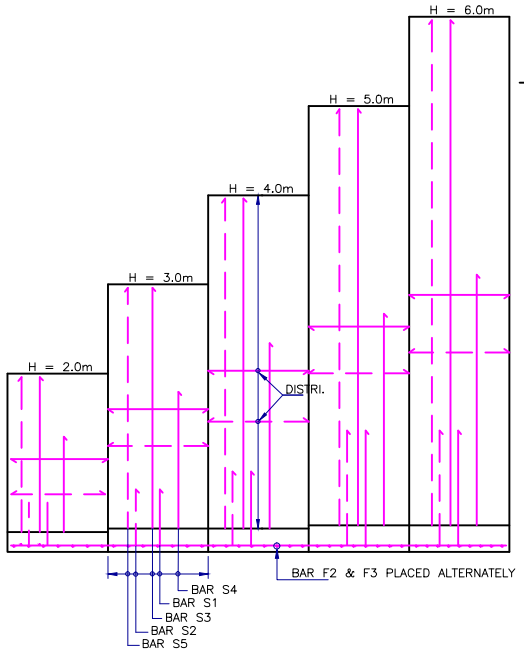
Cable Address Highways Addis Ababa
Telex 21180 Tel.No. 51–71–70/79

RETAINING WALL, R.C. CANTILEVER
2–6m. HIGH WITH NO ROADWAY ON TOP

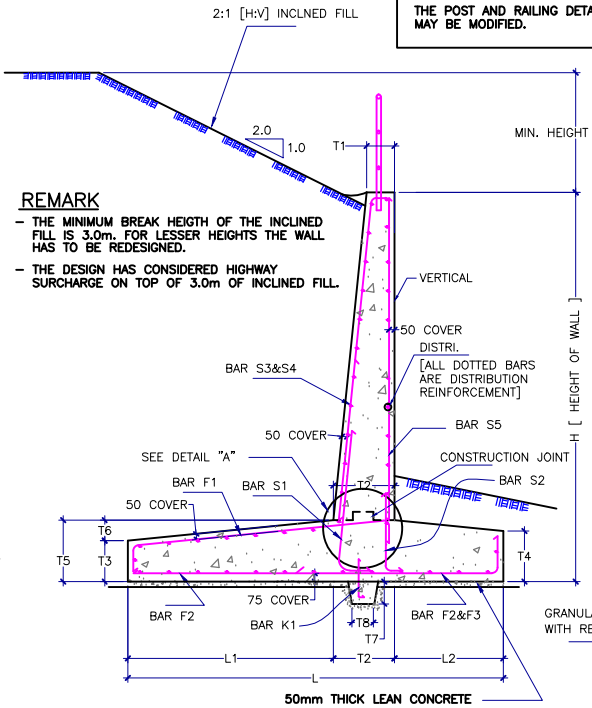
DRAWN	HENOK A.	SCALE:	DRG. NO.
DESIGNED	HENOK A.	AS SHOWN	
CHECKED	L. RAHM	DATE	W – 02
EDITED	S.KIRSTEN	00/00/98	
APPROVED	B.JEBESSA		



FRONT ELEVATION

NOTE

THE POST AND RAILING DETAILS SHOWN MAY BE MODIFIED.

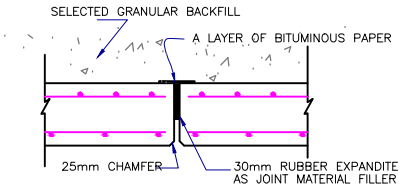


TYPICAL SECTION

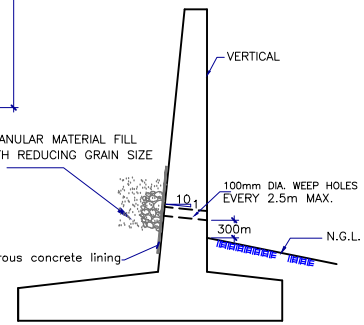
REMARK

- THE MINIMUM BREAK HEIGTH OF THE INCLINED FILL IS 3.0m. FOR LESSER HEIGHTS THE WALL HAS TO BE REDESIGNED.
- THE DESIGN HAS CONSIDERED HIGHWAY SURCHARGE ON TOP OF 3.0m OF INCLINED FILL.

Table of Dimensions of the wall (m), reinforcement steel size, spacing (mm) and quantities per linear meter of wall										
H	2.00		3.00		4.00		5.00		6.00	
T1	0.20		0.20		0.20		0.20		0.20	
T2	0.25		0.30		0.35		0.45		0.55	
T3	0.20		0.20		0.20		0.20		0.28	
T4	0.22		0.25		0.24		0.28		0.36	
T5	0.25		0.30		0.30		0.35		0.45	
T6	0.05		0.10		0.10		0.15		0.18	
T7	–		–		–		–		0.30	
T8	–		–		–		–		0.35	
L1	0.55		1.10		1.35		1.55		1.75	
L2	0.30		0.50		0.60		0.70		0.90	
L	1.10		1.90		2.30		2.70		3.20	
H*	0.67		1.27		1.73		2.07		2.57	
	ø	Spacing	ø	Spacing	ø	Spacing	ø	Spacing	ø	Spacing
Bar S1	10	180	12	80	20	150	24	160	24	130
Bar S2	10	220	10	250	10	270	10	320	10	260
Bar S3	10	360	12	160	20	300	24	320	24	260
Bar S4	10	360	12	160	20	300	24	320	24	260
Bar S5	10	220	10	250	10	270	10	320	10	260
Bar F1	10	450	12	160	16	190	16	130	20	220
Bar F2	10	440	10	440	10	340	12	340	12	260
Bar F3	10	440	10	440	10	340	12	340	12	260
Bar K1	–	–	–	–	–	–	–	–	10	450
Distr. bar	10	220	10	250	10	270	10	320	10	260
Concrete quantity [cu.m/m]	0.65		1.18		1.62		2.32		3.43	
Reinfor. quantity [kg/m]	37.40		80.70		128.10		194.50		269.70	



EXPANSION JOINT HORIZONTAL DETAIL



TYPICAL SECTION SHOWING DETAILS

NOTE

- THE MINIMUM BEND RADIUS OF BARS IS 4*BAR DIAMETER.
- EXPANSION JOINTS SHALL BE PROVIDED EVERY 15m INTERVAL.
- THE BACKFILL MATERIAL SHALL BE SELECTED GRANULAR MATERIAL.
- THE MINIMUM ALLOWABLE BEARING CAPACITY OF THE FOUNDATION MATERIAL SHALL BE 150 & 200 kN/m FOR WALL HEIGHTS LESS THAN 3m AND 3 TO 6m, RESPECTIVELY.
- DURING CASTING OF CONCRETE, IF CONTINUOUS POURING OF CONCRETE IS NOT POSSIBLE, CONSTRUCTION JOINTS SHALL EITHER BE VERTICAL OR HORIZONTAL.
- IF THE THICKNESSES T7 & T8 ARE NOT GIVEN, NO SHEAR KEY IS REQUIRED.
- FOR SMALLER HEIGHTS OF H*, IT IS POSSIBLE TO START BAR S4 FROM BOTTOM OF FOOTING WITH BEND "a" AS SHOWN FOR BAR S1 LEAVING ONLY HALF OF THE No. OF BAR-S1 AS STARTER FOR BAR-S3.

GENERAL NOTES

MANUALS USED-THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL

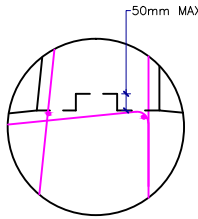
LOADINGS USED:- HL-93=HS20-44 + LANE LOAD ACCORDING TO CHAPTER 3 OF THE ABOVE SPECIFICATIONS.

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED.

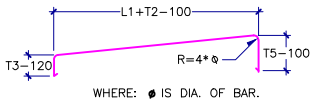
MATERIAL PROPERTIES

CONCRETE:- THE MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS SHALL BE 20MPa (GRADE 20).

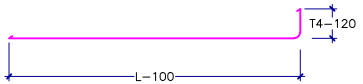
REINFORCEMENT STEEL:- THE MINIMUM YIELD STRENGTH OF DEFORMED BARS SHALL BE 500 MPA IN ACCORDANCE WITH THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATIONS



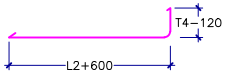
DETAIL "A"



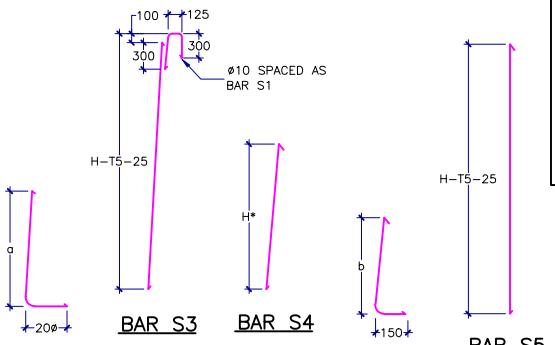
BAR F1



BAR F2



BAR F3



BAR S1 BAR S3 BAR S4 BAR S2 BAR S5

	HEIGHT OF WALL [m]				
	2.0	3.0	4.0	5.0	6.0
a [mm]	430	530	840	1310	1410
b [mm]	430	480	480	530	630

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

REVISIONS

THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
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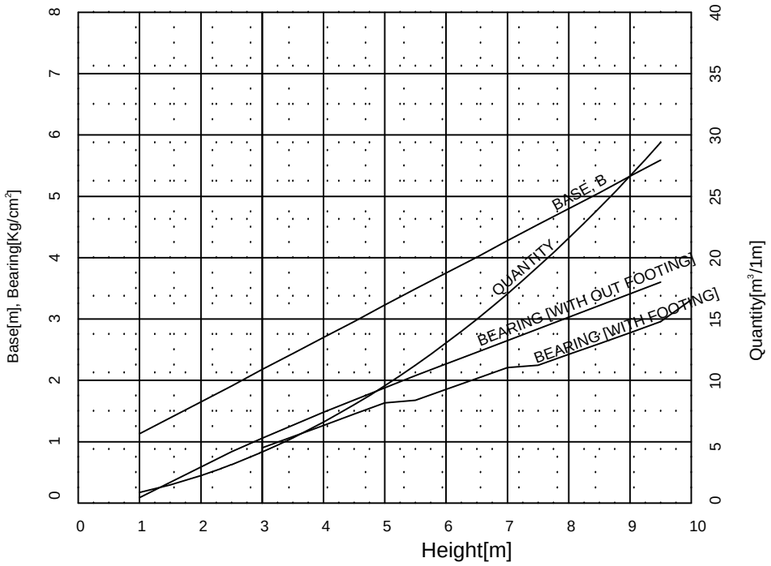
Post Office Box 1770 Addis Ababa Ethiopia
Cable Address Highways Addis Ababa
Telex 21180 Tel.No. 51-71-70/79

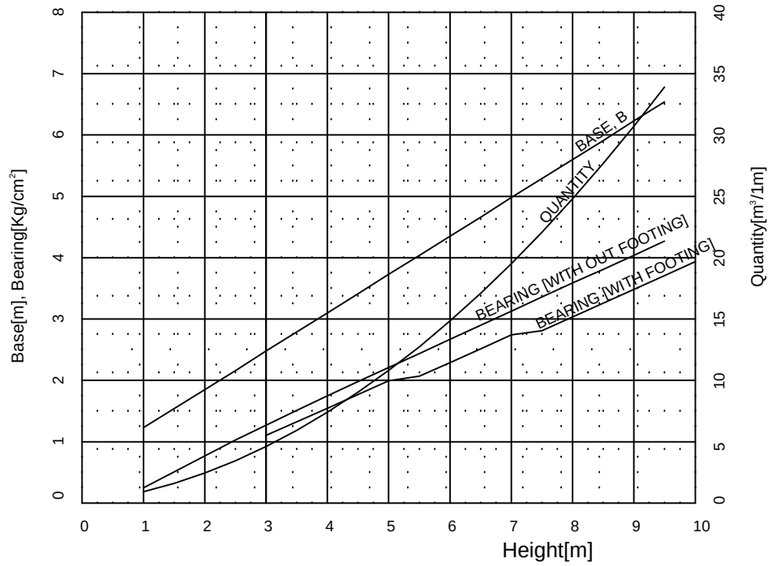
RETAINING WALL R.C. CANTILEVER 2-6m. HIGH WITH 2:1 [H:V] INCLINED FILL

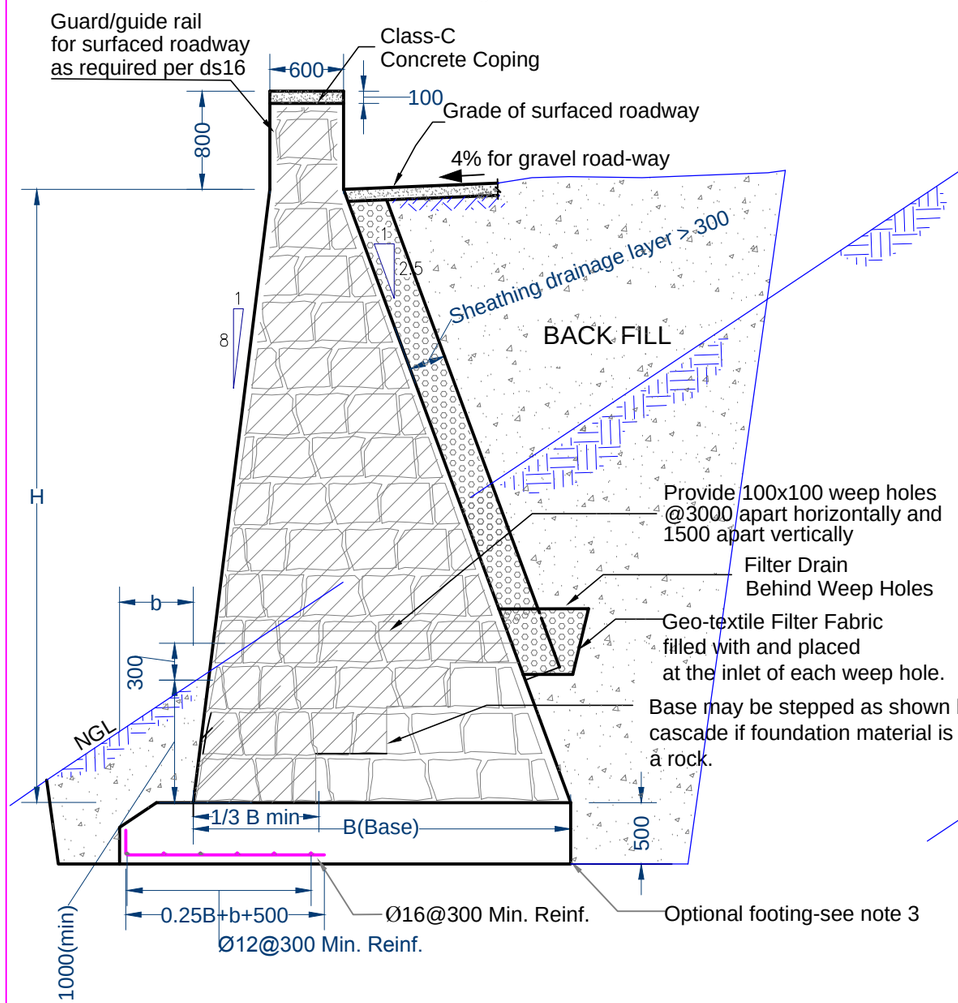
DRAWN	HENOK A.	SCALE:	AS SHOWN
DESIGNED	HENOK A.	DRG. NO.	W - 03
CHECKED	L. RAHM	DATE	28/03/98
EDITED	S.WORSTEN		
APPROVED	B.JEBESSA		

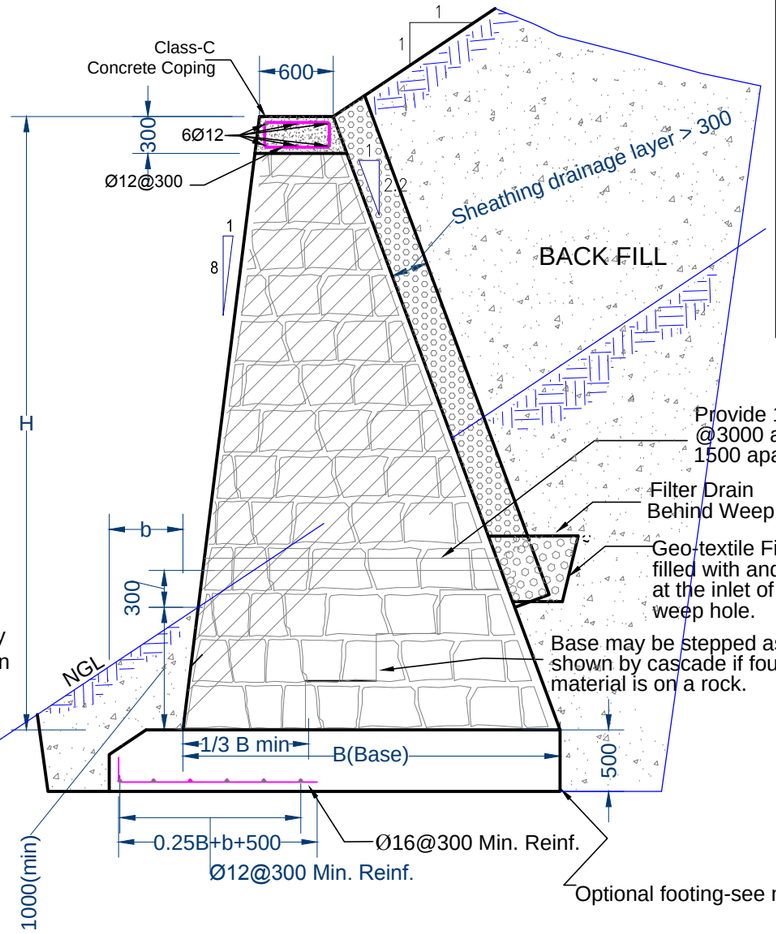
CASE I : HORIZONTAL W/ ROADWAY SURCHARGE OR SLOPING BACKFILL TO 2:1(H:V)



CASE II : SLOPING BACKFILL >2:1 UP TO 1:1 (H:V)







NOTE:-

(1) Design Data:
Weight of masonry 2700Kg/m³
Weight of fill 1600Kg/m³
Surcharge of 0.6m 11.53Kpa
Fluid pressure 528Kg/m³for horizontal fill
Fluid pressure 656Kg/m³for sloping fill

(2) Construction Specifications:-Refer the prevailing version of the ERA Technical Specification.

(3) CLASS OF MASONRY:-class "B" unless otherwise specified.

(4) Wall height shall be limited to the presumptive allow bearing pressure may be taken as²:-
Stiff Clay 2.50Kg/cm² (250KPa)
Dense Sand 2.80Kg/cm² (280KPa)
Weathered rock,Boulders or conglomerate 5.00Kg/cm² (500KPa)
Other presumptive bearing pressure are given in the prevailing version of the AASHTO standard specification for highway bridges, other wise the footing depth & base width are to be as directed by the engineer.

(5) As an alternative if a safe bearing capacity is not encountered at the required depth,a nominally reinforced class-C concrete base may be used to reduce the toe pressure to a safe value as shown on the graph.

(6) SUPPLEMENTAL CONSTRUCTION REQUIREMENTS:-All stones must be thoroughly wetted with water before placing the top surfaces of masonry beds shall be kept free of mortar spillage,and wetted before placing mortar for the next bed of stones.All mortar shall be placed with a trowel.Dumping of mortar on masonry beds from buckets or other containers shall not be permitted under any circumstances.The excessive use of stone fragments for filling voids shall not be permitted.

(7) COMPACTION OF BACK FILL:-Backfill material shall be mechanically compacted in horizontal layers not exceeding 15cm in depth to top of walls.Material above top of wall shall be compacted as specified for embankment.

(8) STONE OR GRAVEL SHEATHING:-Place 0.30m stone or gravel sheathing to 0.30m below weepholes.Material to conform to the prevailing version of the ERA standard specification.

(9) All measurements are in mm unless specified.

H	3 - 5	5.1 - 7	>7≤10
b	300	400	500

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

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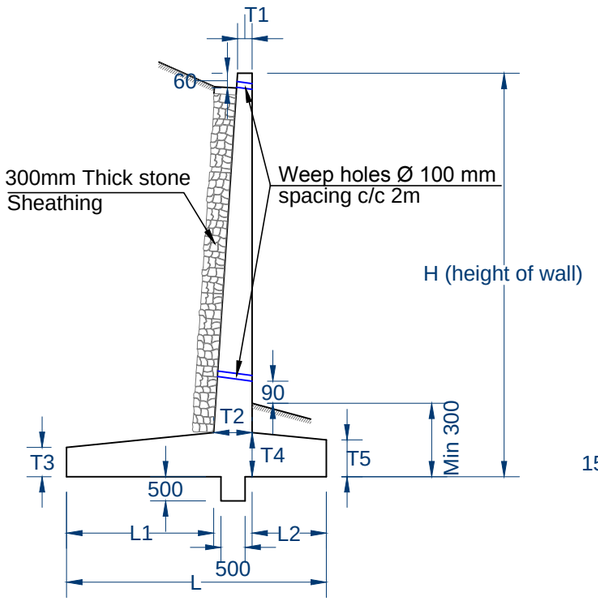
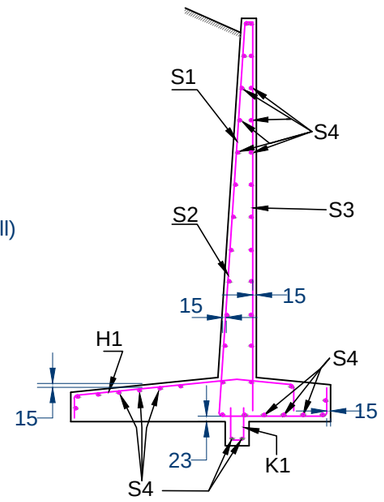
Post Office Box 1770 Addis Ababa Ethiopia
Cable Address Highways Addis Ababa
Telex 21180 Tel.No. 51-71-70/79

MASONRY RETAINING WALL

DRAWN	SCALE: NTS	DRAWING NUMBER
DESIGNED		W-04A
CHECKED		
APPROVED B. JEBESSA	DATE: December 2011	
EDITED S. KIRSTEN		



R.C. CANTILEVER RETAINING WALL
CONCRETE LAYOUT



R.C. CANTILEVER RETAINING WALL
REINFORCEMENT DETAIL

H [m]	T1	T2	T3	T4	T5	L1	L2	L
	IN mm							
6	300	650	300	550	300	2850	1500	5000
7	400	800	350	750	350	3400	1800	6000
8	500	1000	350	750	350	4000	2000	7000

FOR H=6m

Bar Schedule and quantities per linear meter

Bar No.	f [mm]	Spacing c/c [mm]	Number/m	Length [mm]	Weight [kg]
S1	24	340	2.94	6350	66.31
S2	24	340	2.94	4930	51.48
S3	12	300	3.33	5800	17.15
S4	12	300	61	1000	54.17
H1	20	170	5.88	4575	66.38
K1	12	300	3.33	1800	5.33

Concrete---------- 5.05 m^3/m
Reinforcement Steel---------- 260.82 kg/m
Formwork---------- 13.02 m^2/m

FOR H=7m

Bar Schedule and quantities per linear meter

Bar No.	f [mm]	Spacing c/c [mm]	Number/m	Length [mm]	Weight [kg]
S1	30	440	2.27	7450	93.86
S2	30	440	2.27	5950	74.96
S3	12	240	4.17	6800	25.18
S4	12	240	89	1000	79.03
H1	24	210	4.76	5600	94.72
K1	12	300	3.33	1800	5.33

Concrete---------- 7.46 m^3/m
Reinforcement Steel---------- 373.08 kg/m
Formwork---------- 15.02 m^2/m

FOR H=8m

Bar Schedule and quantities per linear meter

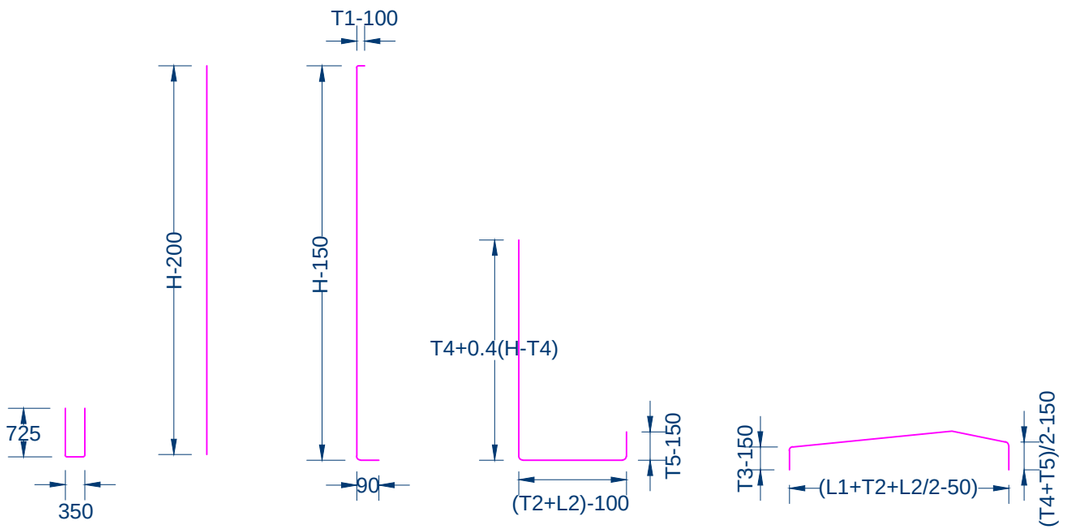
Bar No.	f [mm]	Spacing c/c [mm]	Number/m	Length [mm]	Weight [kg]
S1	30	340	2.94	8550	139.51
S2	30	340	2.94	6750	110.14
S3	12	200	5.00	7800	34.63
S4	12	200	121	1000	107.45
H1	24	130	7.69	6500	177.60
K1	12	300	3.33	1800	5.33

Concrete---------- 9.74 m^3/m
Reinforcement Steel---------- 574.66 kg/m
Formwork---------- 17.02 m^2/m

NOTE:

- Concrete: Class 30/20 [Min.] 150x150x150 Cube Cube Compressive Strength at 28 days
- Steel: The following minimum yeild strength and lap length shall be provided.

BAR SIZE (mm)	YEILD STRENGTH MIN. [MPa]	GRADE
12,16,20	278	40
24,30	410	60



BAR K1 BAR S3 BAR S1 BAR S2 BAR H1 BAR S4

NOTE:

-Bar dimensions are out to out
-All bars shall be deformed
-All dimensions are in mm unless specified
-Minimum pin diameter shall be 5Ø [5 times bar diameter]
-The minimum allowable toe bearing capacity shall be 200KPa

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

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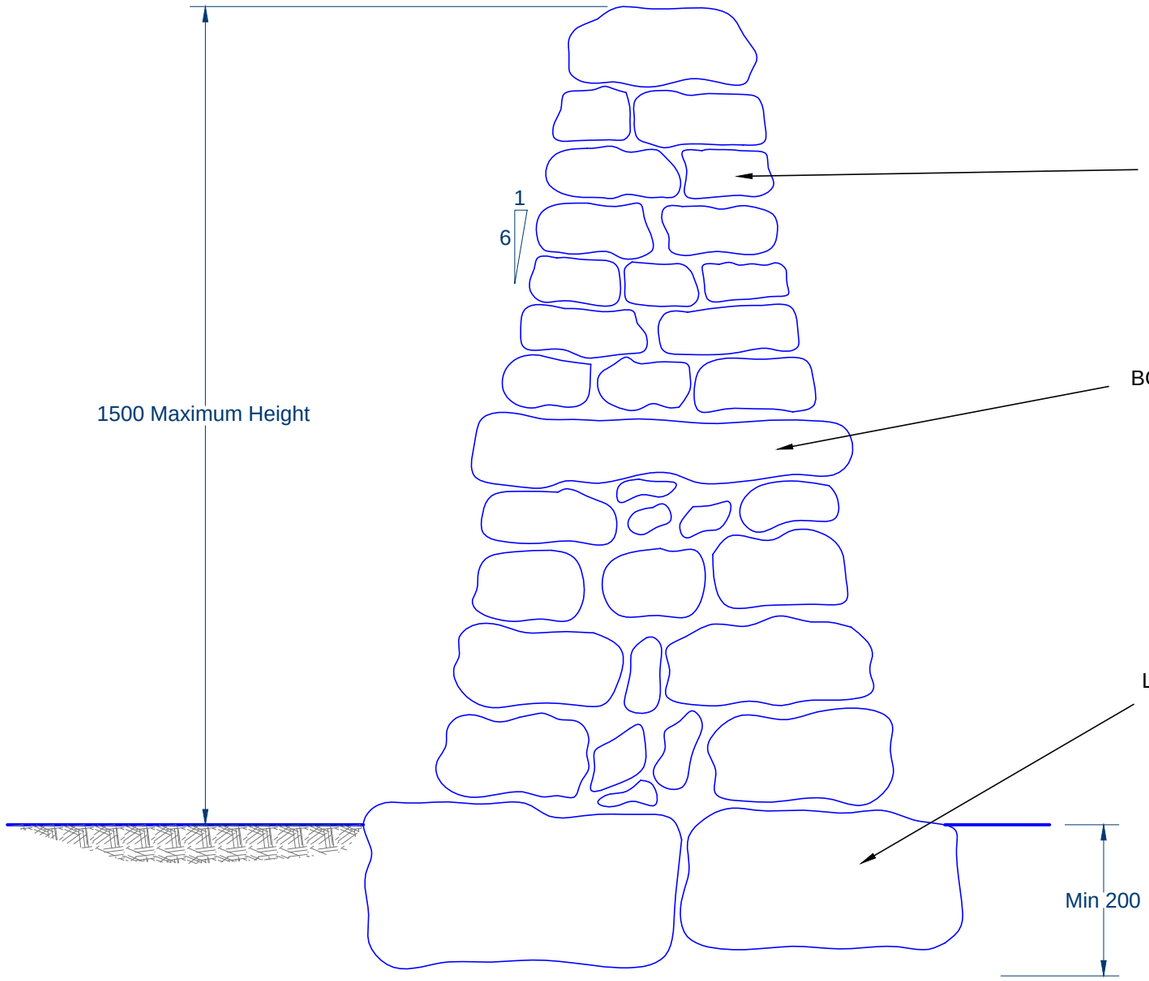
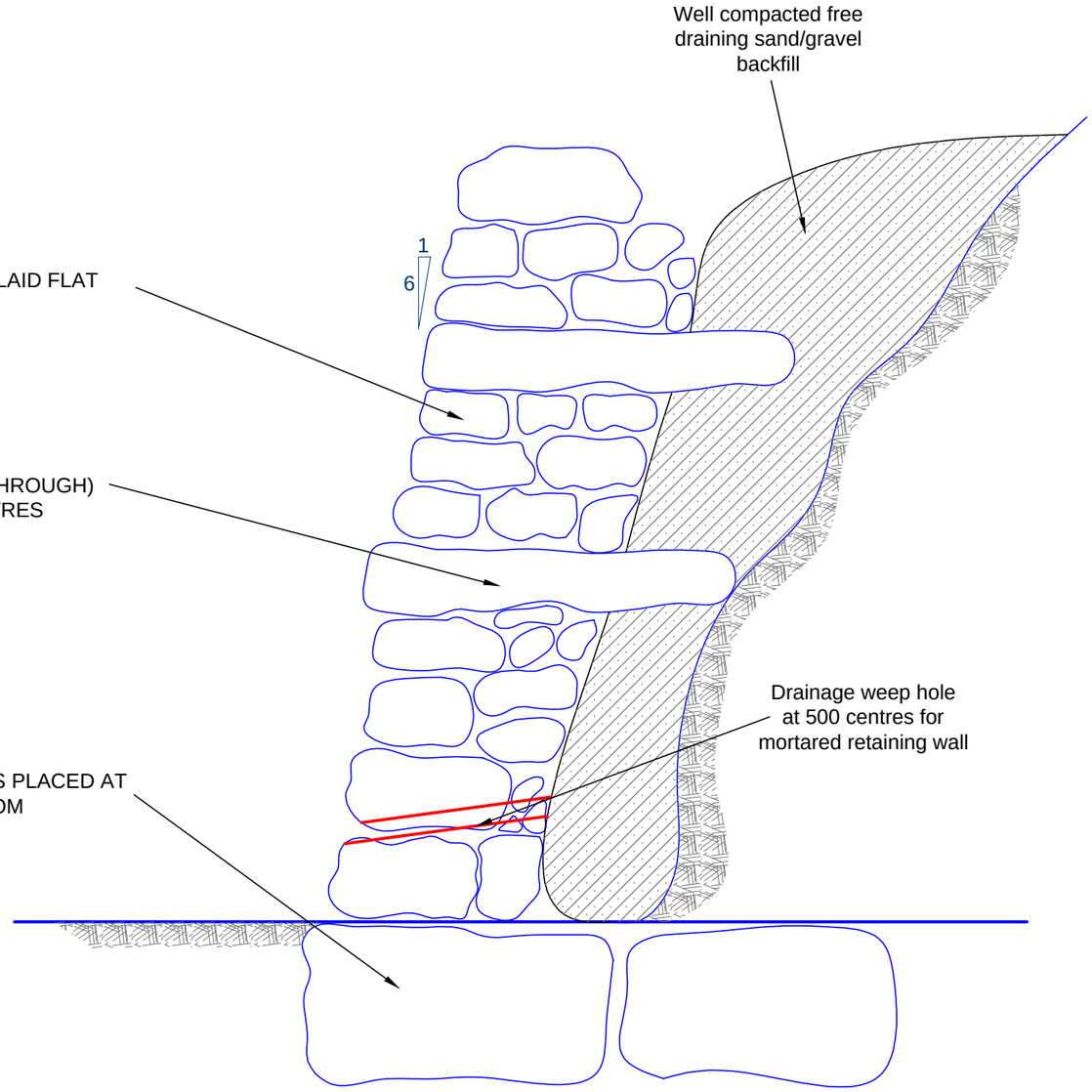
Telex 21180 Tel.No. 51-71-70/79

RC RETAINING WALL

DRAWN		SCALE: NTS	DRAWING NUMBER
DESIGNED			W-04B
CHECKED		DATE: December 2011	
APPROVED	B. JEBESSA		
EDITED	S. KIRSTEN		



FREE STANDING DRY OR MORTARED WALL



DRY OR MORTARED RETAINING WALL

Note:-
1. All dimensions in millimeters
2. If bond stones of suitable dimension are not available they can be substituted with Class C 20/20 concrete (150 x 150 min cross section)
3. For mortared wall stones placed the same as dry stone wall except stones bedded on mortared layer.

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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B					
A					

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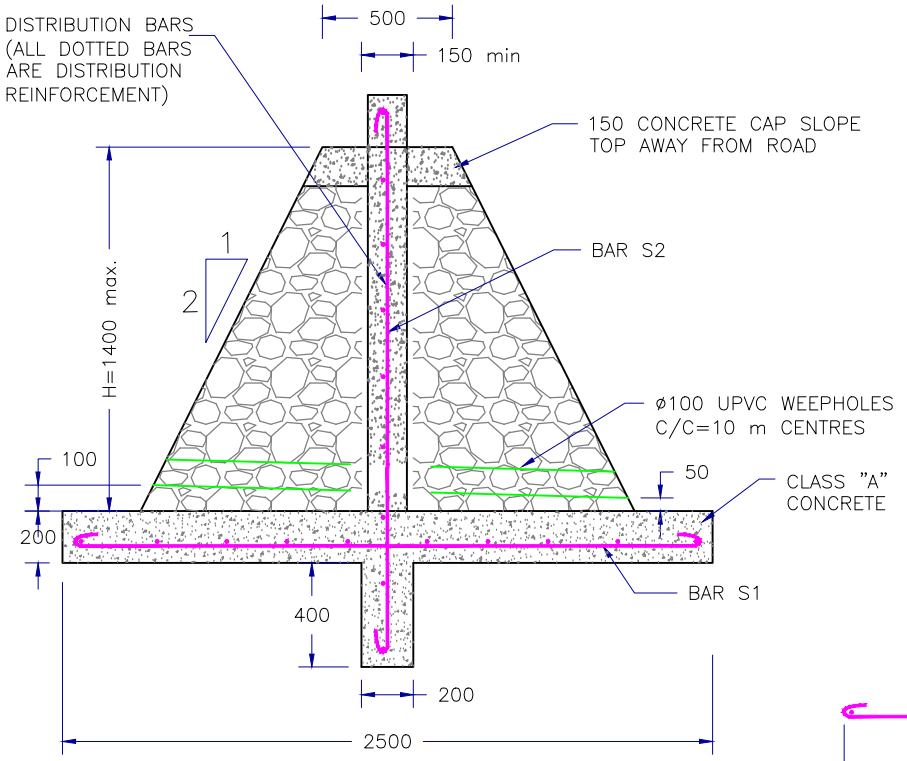
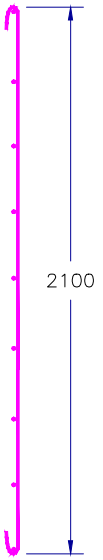
Telex 21180 Tel.No. 51-71-70/79

DRY AND MORTARED STONE WALL

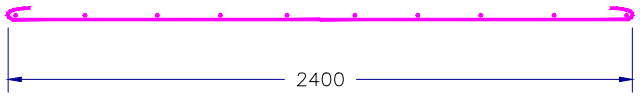
DRAWN		SCALE: NTS	DRAWING NUMBER
DESIGNED			W-04c
CHECKED		DATE: December 2011	
APPROVED	B. JEBESSA		
EDITED	S. KIRSTEN		



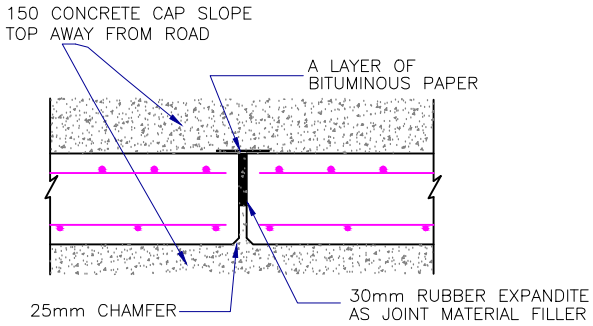
TYPICAL SECTION



BAR S2



BAR S1



EXPANSION JOINT HORIZONTAL DETAIL
(NOT SCALE)

REINFORCING BAR SCHEDULE

	ø	SPACING
BAR S1	12	250
BAR S2	12	250
DISTR. BAR	10	220
CONCRETE QUANTITY (m3/m)	0.86	
REINFORCING QUANTITY (kg/m)	27.70	

NOTE

- THE MINIMUM BEND RADIUS OF BARS IS 4*BAR DIAMETER.
- EXPANSION JOINTS SHALL BE PROVIDED EVERY 15m INTERVAL.
- THE BACKFILL MATERIAL SHALL BE SELECTED GRANULAR MATERIAL.
- THE MINIMUM ALLOWABLE BEARING CAPACITY OF THE FOUNDATION MATERIAL SHALL BE 150 & 200 kN/m FOR WALL HEIGHTS LESS THAN 3m AND 3 TO 6m, RESPECTIVELY.
- DURING CASTING OF CONCRETE, IF CONTINUOUS POURING OF CONCRETE IS NOT POSSIBLE, CONSTRUCTION JOINTS SHALL EITHER BE VERTICAL OR HORIZONTAL.

GENERAL NOTES

MANUALS USED–THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL

LOADINGS USED:– HL–93=HS20–44 + LANE LOAD ACCORDING TO CHAPTER 3 OF THE ABOVE SPECIFICATIONS.

ALL DIMENSIONS ARE IN MILLIMETERS UNLESS NOTED.

MATERIAL PROPERTIES

CONCRETE:– THE MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH AT 28 DAYS SHALL BE 20MPa (GRADE 20).

REINFORCEMENT STEEL:– THE MINIMUM YIELD STRENGTH OF DEFORMED BARS SHALL BE 500 MPA IN ACCORDANCE WITH THE PREVAILING VERSION OF THE ERA BRIDGE DESIGN MANUAL FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATIONS

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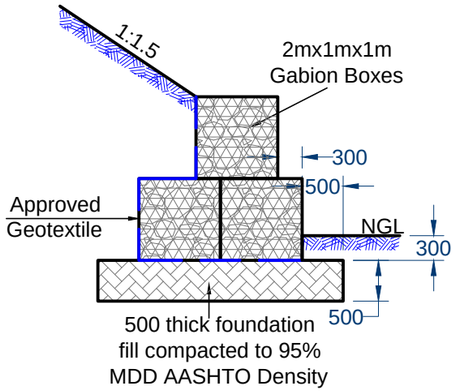
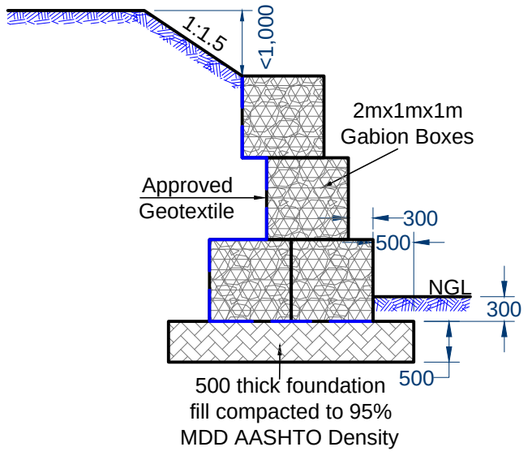
MASONRY RETAINING WALL

DRAWN	HENOK A.	SCALE:	DRG. NO.
DESIGNED	HENOK A.	1/20	W – 05
CHECKED	L. RAHM	DATE	
EDITED	S. KIRSTEN	28/03/98	
APPROVED	B. JEBESSA		

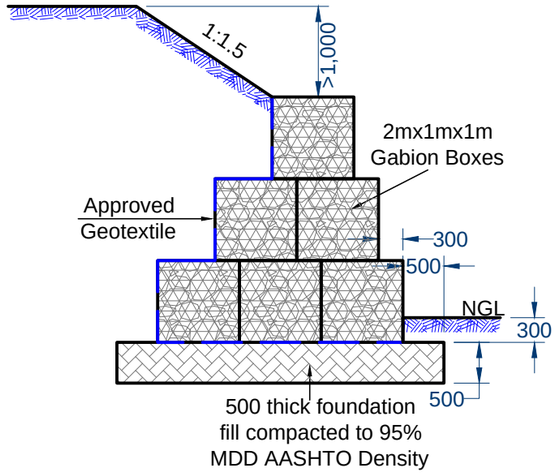


2m GABION WALL



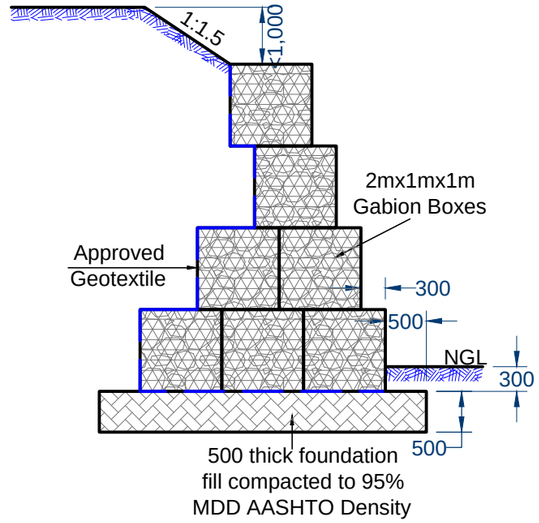
Maximum permissible
bearing pressure=333 kpa

3m GABION WALL: CASE 1



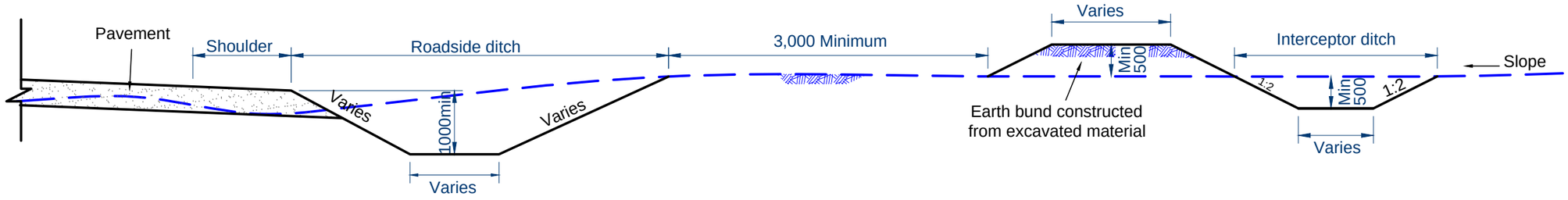
Maximum permissible
bearing pressure=150 kpa

3m GABION WALL: CASE 2



Maximum permissible
bearing pressure=215 kpa

4m GABION WALL



TYPICAL CROSS-SECTION SHOWING EARTH BUND INTERCEPTION DITCH

Note:
1. All dimensions in mm.
2. Dimensions to be instructed by the Engineer.
3. For gabions founded on rock foundation use concrete Class 15/20 leveling layer, minimum thickness 50 mm.

KEY
- Pavement
- Gabion
- Firm foundation/ Existing ground

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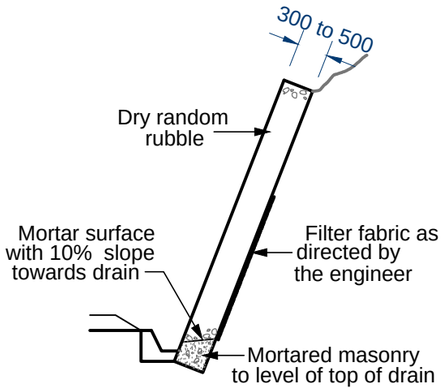
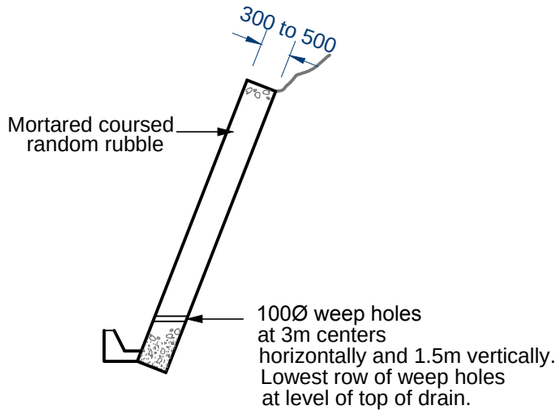
CUT-OFF AND OUTFALL DRAINAGE
AND GABION WALLS

DRAWN	SCALE: 1:75 (at A3)	DRAWING NUMBER
DESIGNED		W-06
CHECKED		
APPROVED B. JEBESSA	DATE: December 2011	
EDITED S. KIRSTEN		

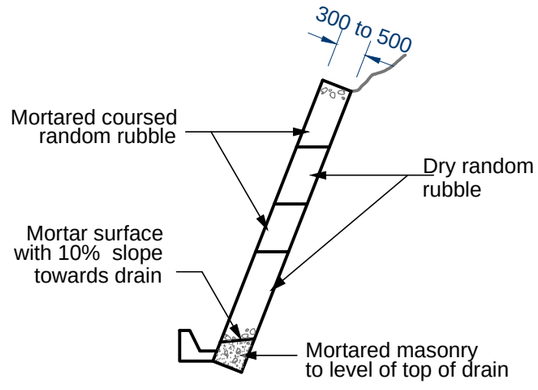
Type of revetment


300 to 500
Dry random rubble
Mortar surface with 10% slope towards drain
Filter fabric as directed by the engineer
Mortared masonry to level of top of drain

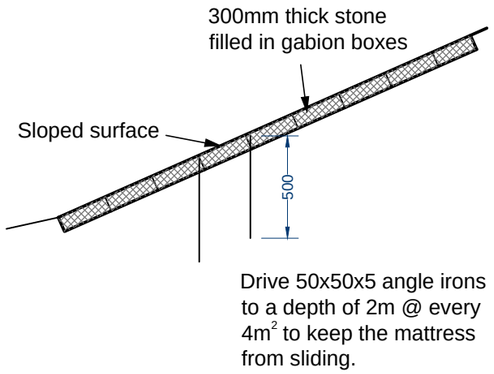
Dry random rubble type


300 to 500
Mortared coursed random rubble
100Ø weep holes at 3m centers horizontally and 1.5m vertically.
Lowest row of weep holes at level of top of drain.

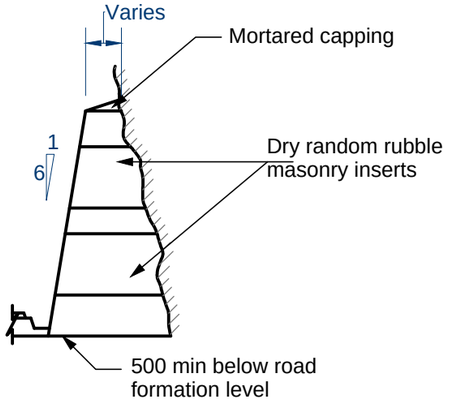
Mortared coursed random rubble type

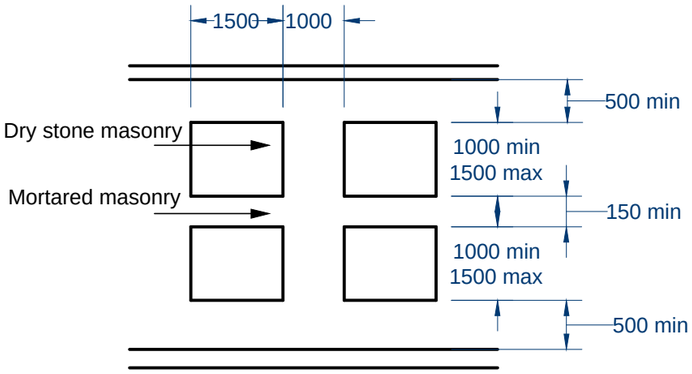

300 to 500
Mortared coursed random rubble
Dry random rubble
Mortar surface with 10% slope towards drain
Mortared masonry to level of top of drain

Composite type

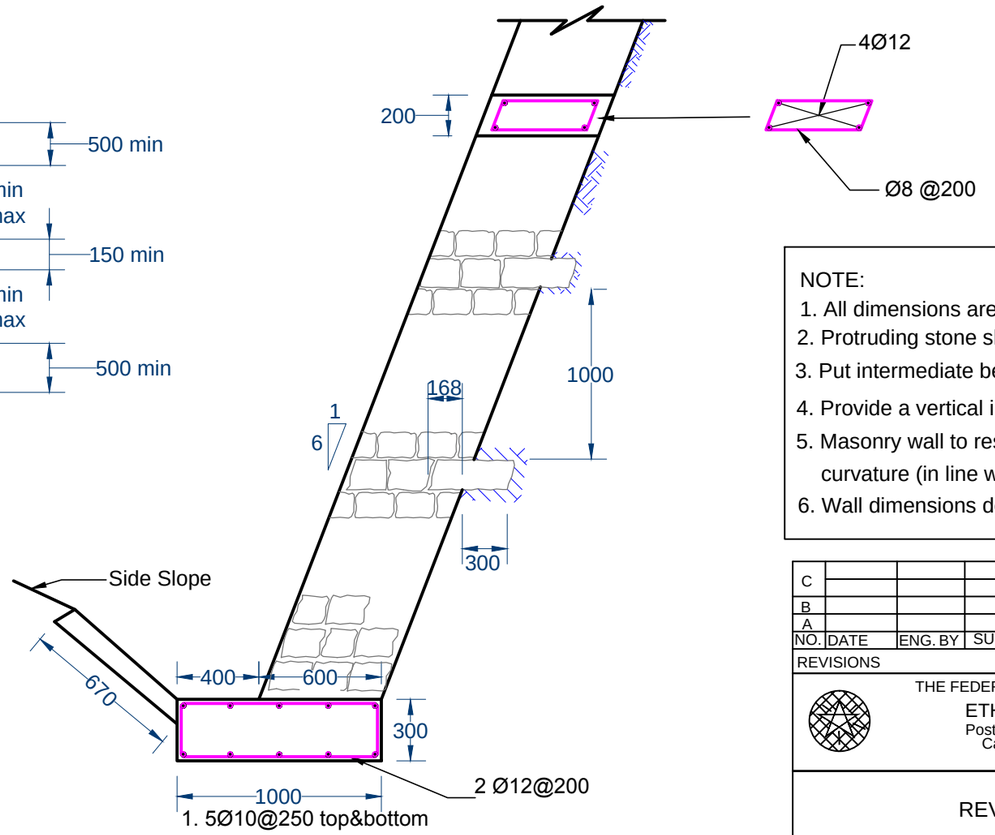

300mm thick stone filled in gabion boxes
Sloped surface
500
Drive 50x50x5 angle irons to a depth of 2m @ every 4m² to keep the mattress from sliding.

Reno-Mattress Type





Composite masonry rock face protection wall



Typical mortared masonry revetment resting on class C20/20 Concrete footing

NOTE:
1. All dimensions are in mm
2. Protruding stone should be inserted every 1.0 m
3. Put intermediate beams at 3.0 m vertical interval.
4. Provide a vertical interval expansion joint every 23.0 m.
5. Masonry wall to resume the back slope ratio and curvature (in line with the constructed wall in the trial stretch).
6. Wall dimensions designed to suit conditions.

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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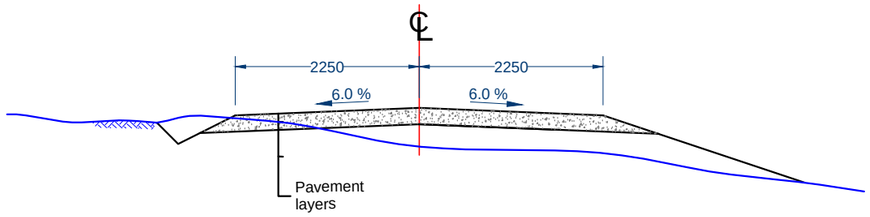
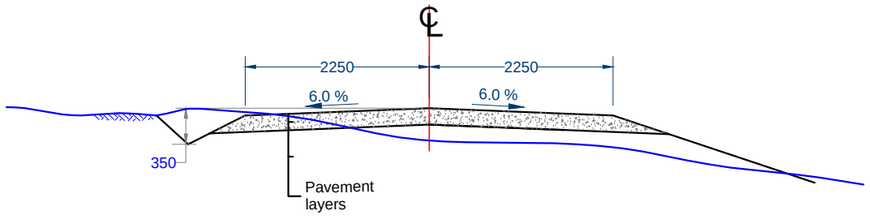
REVETMENT STRUCTURES

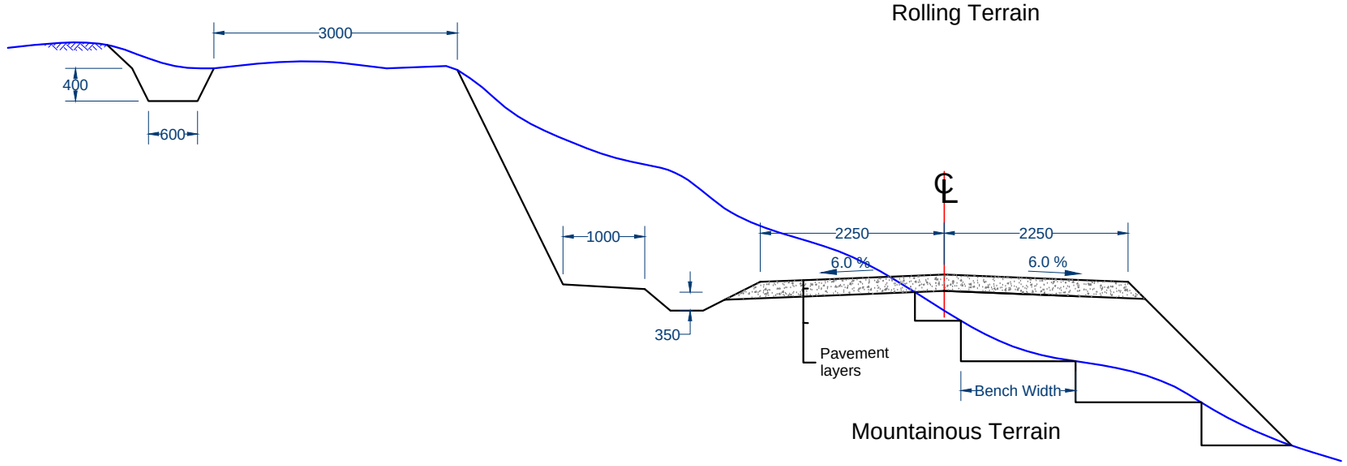
DRAWN		SCALE: NTS	DRAWING NUMBER
DESIGNED			W-07
CHECKED		DATE: December 2011	
APPROVED	B. JEBESSA		
EDITED	S. KIRSTEN		



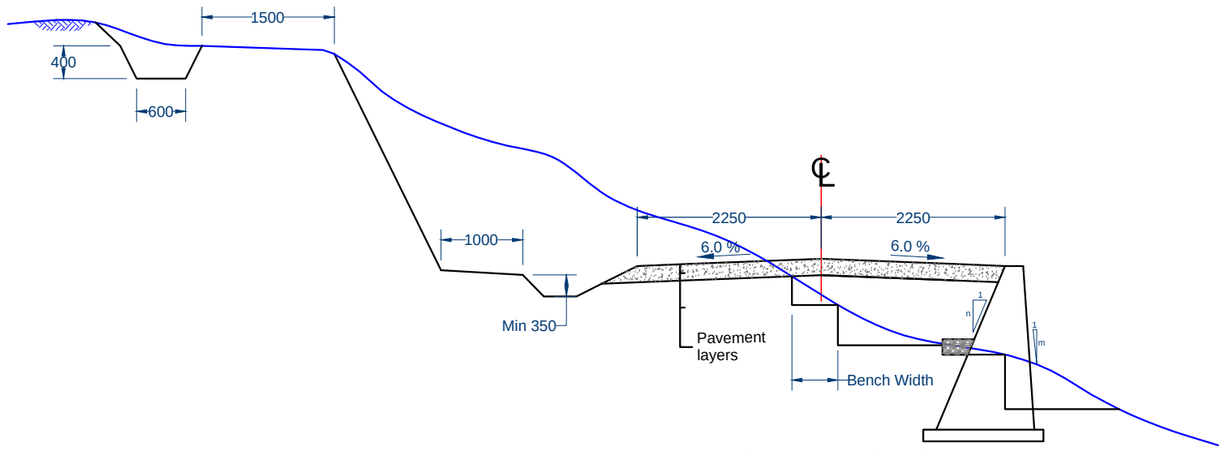
Flat Terrain



Rolling Terrain



Mountainous Terrain



Escarpment Terrain

Slope Ratio Table

Material	Height of slope	Side slope		Back slope	Safety classification
		Cut	Fill		
Earth	0.0 - 1.0	1:4	1:4	1:3	Recoverable
	1.0 - 2.0	1:3	1:3	1:2	Not recoverable
	> 2.0	1:2	1:2	1:1.5	Critical
Rock	Any height	Dependent on cost			Critical
Expansive clay [1]	0.0 - 1.0	1:4	1:4	1:3	Recoverable
	1.0 - 2.0	1:3	1:3	1:2	

Note:-

[1] Certain soils may be not stable at 1:2, geotechnical advice required.

Drainage ditch should be moved away from the embankment.

Note:-

1. All dimension in mm.
2. V-shaped is the standard shape for the drainage ditch constructed by grader.
3. Trapezoidal drains are commonly used and are much easier to dig and clean using labour-intensive methods. The minimum recommended width is 400mm.
4. In case of deep cut more than 10m, benching is recommended.
5. Use benching for ground traverse slope of 25% and more.
6. Benching on fill section shall be provided for transverse cross slope of the ground more than 25 % and the bench width shall be minimum of 2.5m.
7. Refer Drawings D-06 and D-07 for ditch detail.

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B					
A					

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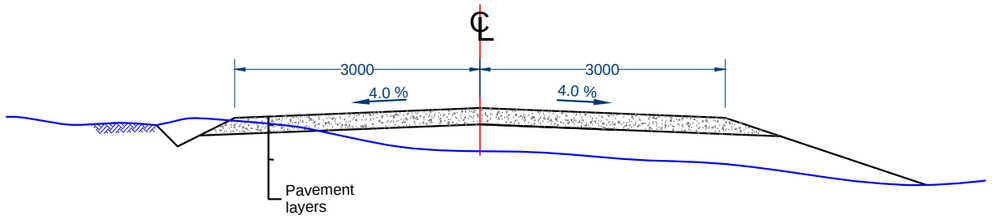
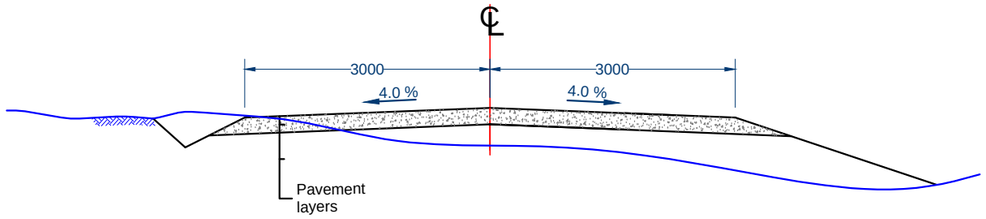
DC1, TYPICAL CROSS SECTION (RURAL)

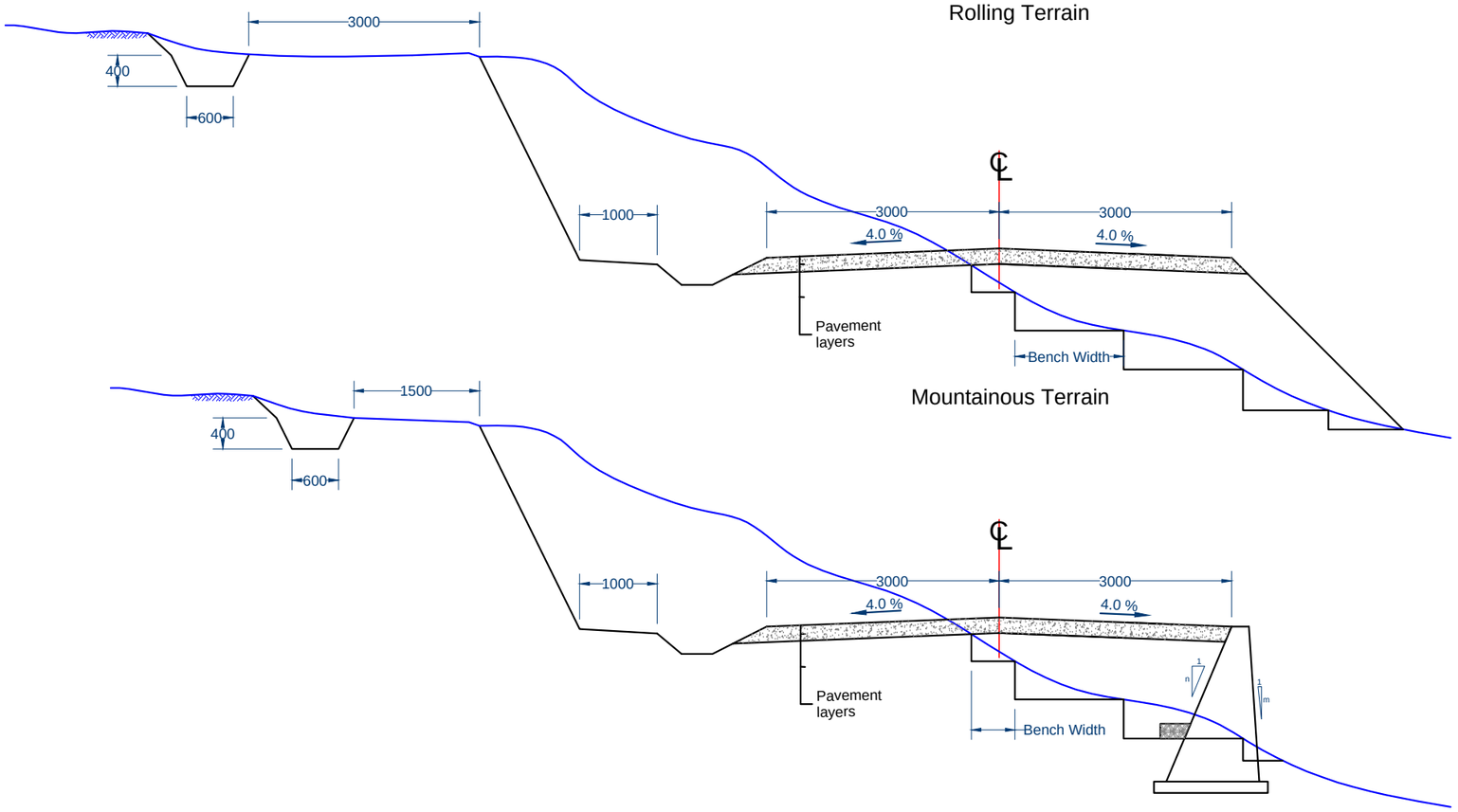
DRAWN		SCALE: 1:75 (at A3)	DRAWING NUMBER
DESIGNED			W-08A
CHECKED		DATE: December 2011	
APPROVED	B. JEBESSA		
EDITED	S. KIRSTEN		



Flat Terrain



Rolling Terrain



Mountainous Terrain

Escarpment Terrain

Slope Ratio Table

Material	Height of slope	Side slope		Back slope	Safety classification
		Cut	Fill		
Earth	0.0 - 1.0	1:4	1:4	1:3	Recoverable
	1.0 - 2.0	1:3	1:3	1:2	Not recoverable
	> 2.0	1:2	1:2	1:1.5	Critical
Rock	Any height	Dependent on cost			Critical
Expansive clay (1)	0.0 - 1.0	1:4	1:4	1:3	Recoverable
	1.0 - 2.0	1:3	1:3	1:2	

Note:-
(1) Certain soils may be not stable at 1:2, geotechnical advice required.
Drainage ditch should be moved away from the embankment.

Note:-
1. All dimension in mm.
2. V-shaped is the standard shape for the drainage ditch constructed by grader.
3. Trapezoidal drains are commonly used and are much easier to dig and clean using labour-intensive methods. The minimum recommended width is 400mm.
4. In case of deep cut more than 10m, benching is recommended.
5. Use benching for ground traverse slope of 25% and more.
6. Benching on fill section shall be provided for transverse cross slope of the ground more than 25 % and the bench width shall be minimum of 2.5m.
7. Refer Drawings D-06 and D-07 for ditch detail.

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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B					
A					

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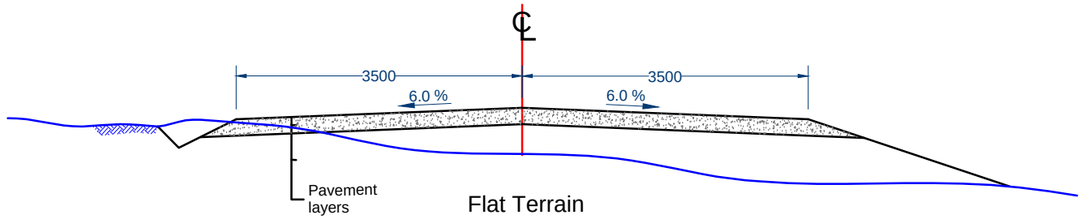
Telex 21180 Tel.No. 51-71-70/79

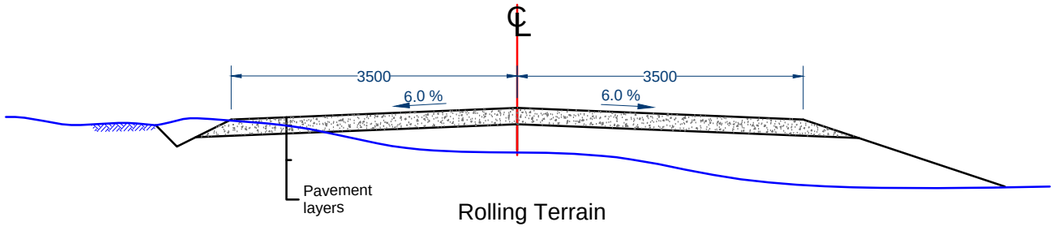
DC2, UNPAVED TYPICAL CROSS SECTION (RURAL)

DRAWN		
DESIGNED		SCALE: 1:75 (at A3)
CHECKED		
APPROVED	B. JEBESSA	DATE: December 2011
EDITED	S. KIRSTEN	

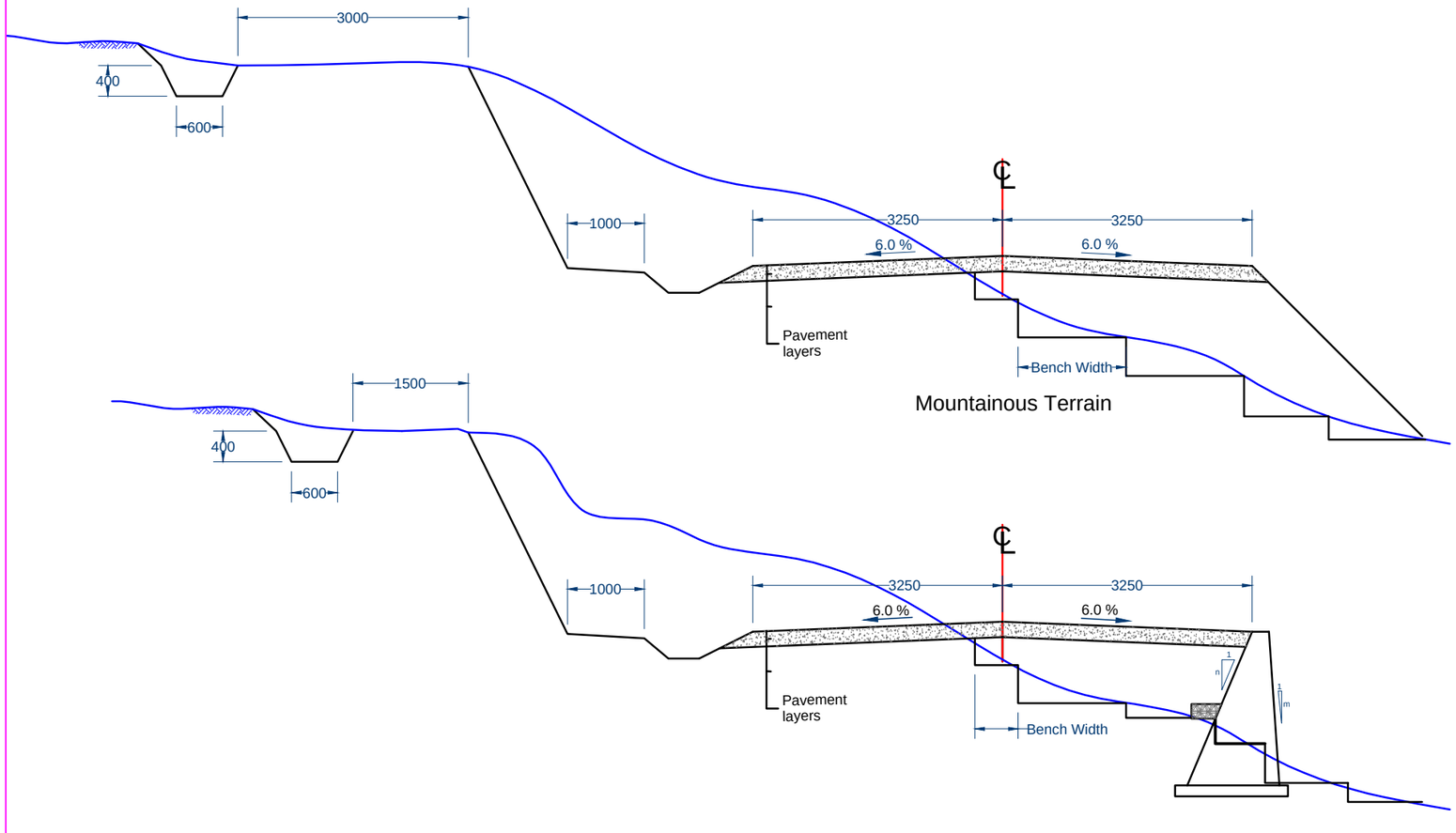
DRAWING NUMBER
W-08B



Flat Terrain



Rolling Terrain



Mountainous Terrain

Escarpment Terrain

Slope Ratio Table

Material	Height of slope	Side slope		Back slope	Safety classification
		Cut	Fill		
Earth	0.0 - 1.0	1:4	1:4	1:3	Recoverable
	1.0 - 2.0	1:3	1:3	1:2	Not recoverable
	> 2.0	1:2	1:2	1:1.5	Critical
Rock	Any height	Dependent on cost			Critical
Expansive clay [1]	0.0 - 1.0	1:4	1:4	1:3	Recoverable
	1.0 - 2.0	1:3	1:3	1:2	

Note:-

[1] Certain soils may be not stable at 1:2, geotechnical advice required.

Drainage ditch should be moved away from the embankment.

Note:-

1. All dimension in mm.
2. V-shaped is the standard shape for the drainage ditch constructed by grader.
3. Trapezoidal drains are commonly used and are much easier to dig and clean using labour-intensive methods. The minimum recommended width is 400mm.
4. In case of deep cut more than 10m, benching is recommended.
5. Use benching for ground traverse slope of 25% and more.
6. Benching on fill section shall be provided for transverse cross slope of the ground more than 25 % and the bench width shall be minimum of 2.5m.
7. Refer Drawings D-06 and D-07 for ditch detail.

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

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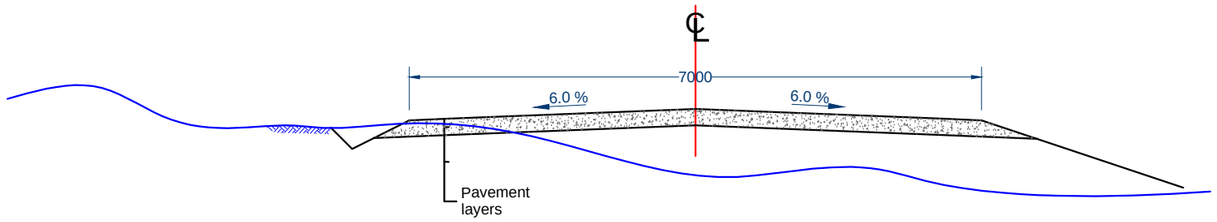
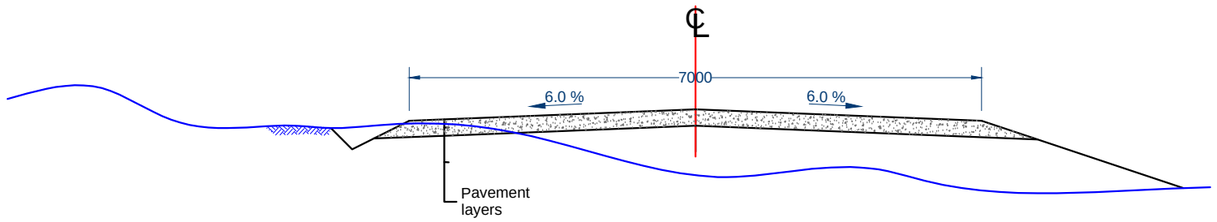
DC3, UNPAVED TYPICAL CROSS SECTION (RURAL)

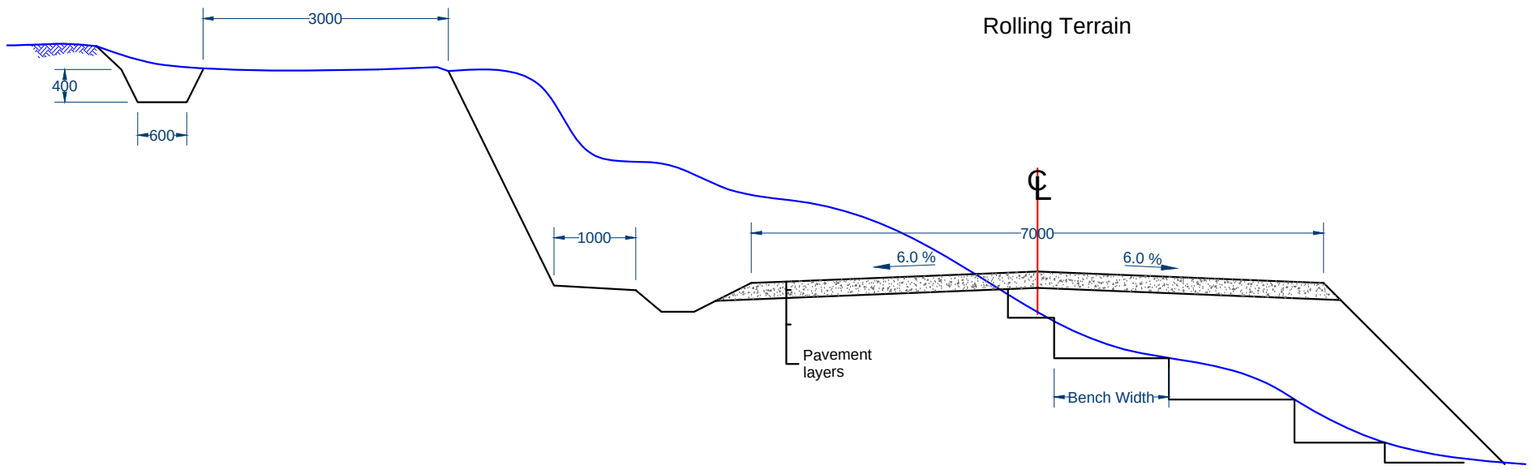
DRAWN	SCALE: 1:75 (at A3)	DRAWING NUMBER
DESIGNED		W-08c
CHECKED		
APPROVED B. JEBESSA	DATE: December 2011	
EDITED S. KIRSTEN		



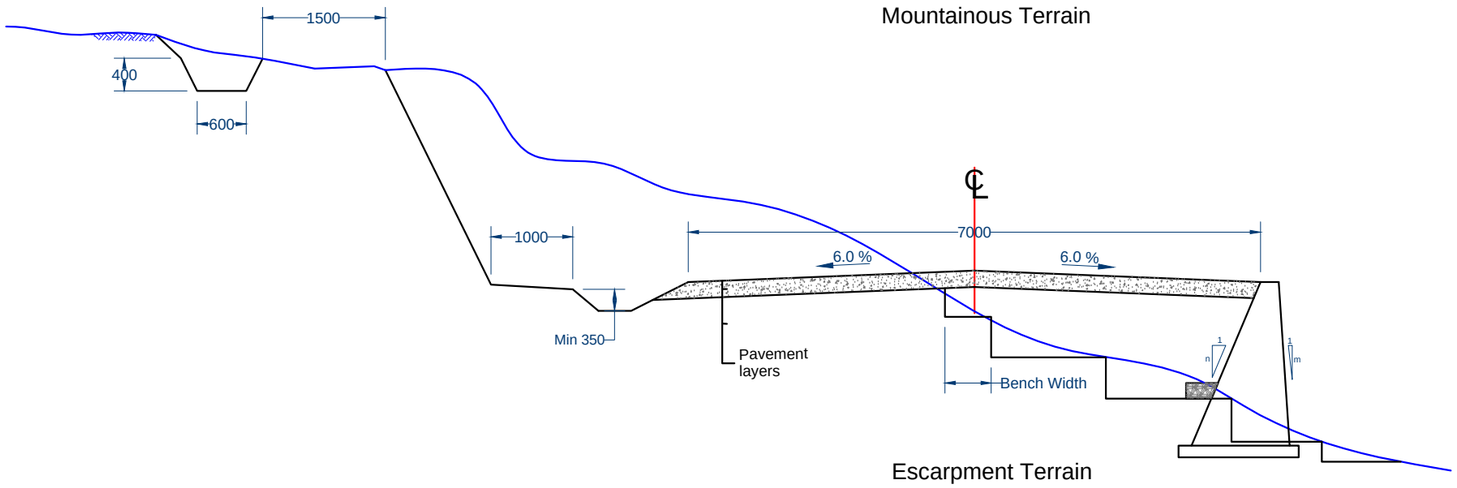
Flat Terrain



Rolling Terrain



Mountainous Terrain



Escarpment Terrain

Slope Ratio Table

Material	Height of slope	Side slope Cut	Side slope Fill	Back slope	Safety classification
Earth	0.0 - 1.0	1:2	1:4	1:3	Recoverable
	1.0 - 2.0	1:2	1:3	1:2	Not recoverable
	> 2.0	1:2	1:2	1:1.5	Critical
Rock	Any height	Dependent on cost			Critical
Expansive clay (1)	0.0 - 1.0	1:2	1:4	1:3	Recoverable
	1.0 - 2.0	1:2	1:3	1:2	

Note:-
(1) Certain soils may be not stable at 1:2, geotechnical advice required.
Drainage ditch should be moved away from the embankment.

Note:-
1. All dimension in mm.
2. V-shaped is the standard shape for the drainage ditch constructed by grader.
3. Trapezoidal drains are commonly used and are much easier to dig and clean using labour-intensive methods. The minimum recommended width is 400mm.
4. In case of deep cut more than 10m, benching is recommended.
5. Use benching for ground traverse slope of 25% and more.
6. Benching on fill section shall be provided for transverse cross slope of the ground more than 25 % and the bench width shall be minimum of 2.5m.
7. Refer Drawings D-06 and D-07 for ditch detail.

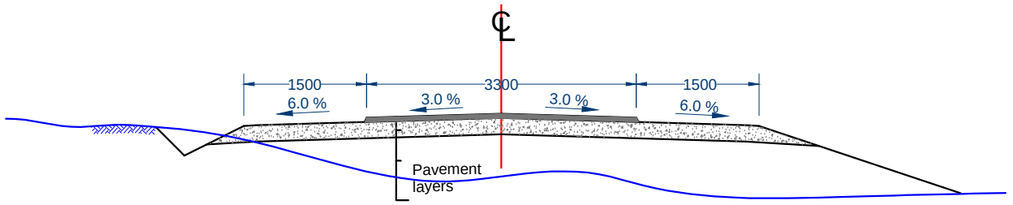
NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
C					
B					
A					

REVISIONS

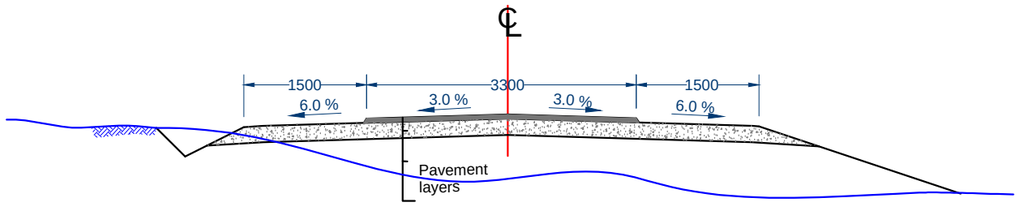
THE FEDERAL DEMOCRATIC REPUBLIC OF ETHIOPIA
ETHIOPIAN ROADS AUTHORITY
Post Office Box 1770 Addis Ababa Ethiopia
Cable Address Highways Addis Ababa
Telex 21180 Tel.No. 51-71-70/79

DC4, UNPAVED TYPICAL CROSS SECTION (RURAL)

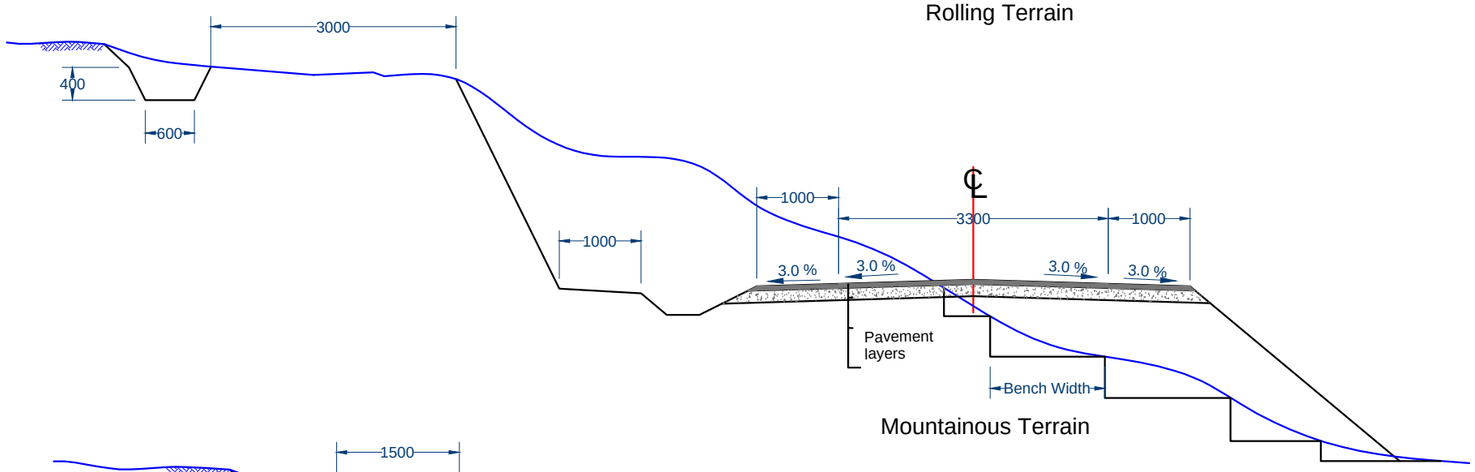
DRAWN		SCALE: 1:75 (at A3)	DRAWING NUMBER
DESIGNED			W-08D
CHECKED		DATE: December 2011	
APPROVED	B. JEBESSA		
EDITED	S. KIRSTEN		



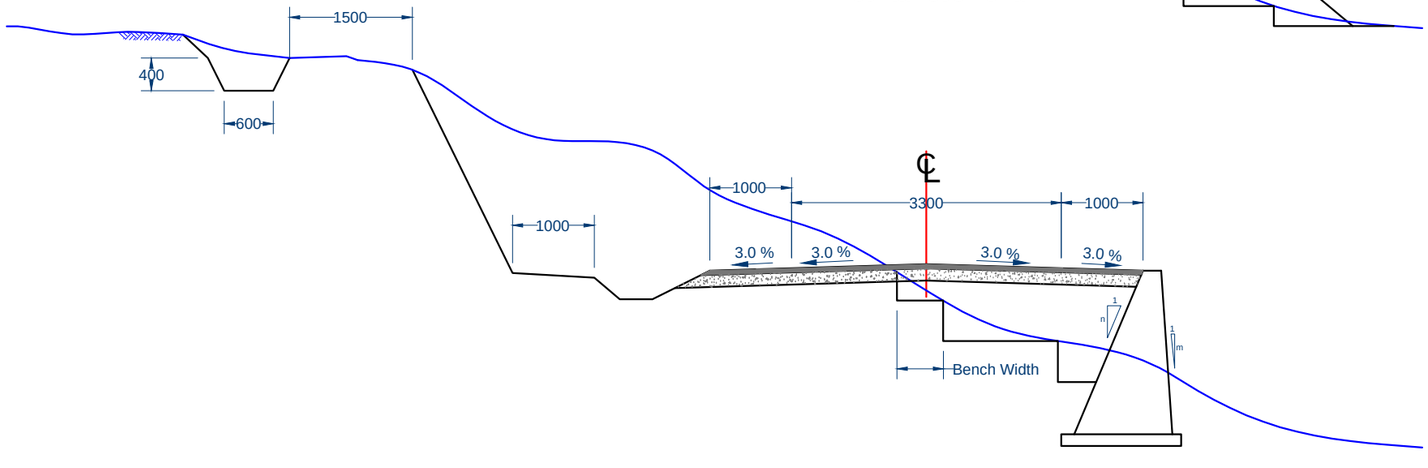
Flat Terrain



Rolling Terrain



Mountainous Terrain



Escarpment Terrain

Slope Ratio Table

Material	Height of slope	Side slope		Back slope	Safety classification
		Cut	Fill		
Earth	0.0 - 1.0	1:4	1:4	1:3	Recoverable
	1.0 - 2.0	1:3	1:3	1:2	Not recoverable
	> 2.0	1:2	1:2	1:1.5	Critical
Rock	Any height	Dependent on cost			Critical
Expansive clay [1]	0.0 - 1.0	1:4	1:4	1:3	Recoverable
	1.0 - 2.0	1:3	1:3	1:2	

Note:-
[1] Certain soils may be not stable at 1:2, geotechnical advice required.
Drainage ditch should be moved away from the embankment.

Note:-
1. All dimension in mm.
2. V-shaped is the standard shape for the drainage ditch constructed by grader.
3. Trapezoidal drains are commonly used and are much easier to dig and clean using labour-intensive methods. The minimum recommended width is 400mm.
4. In case of deep cut more than 10m, benching is recommended.
5. Use benching for ground traverse slope of 25% and more.
6. Benching on fill section shall be provided for transverse cross slope of the ground more than 25 % and the bench width shall be minimum of 2.5m.
7. Refer Drawings D-06 and D-07 for ditch detail.

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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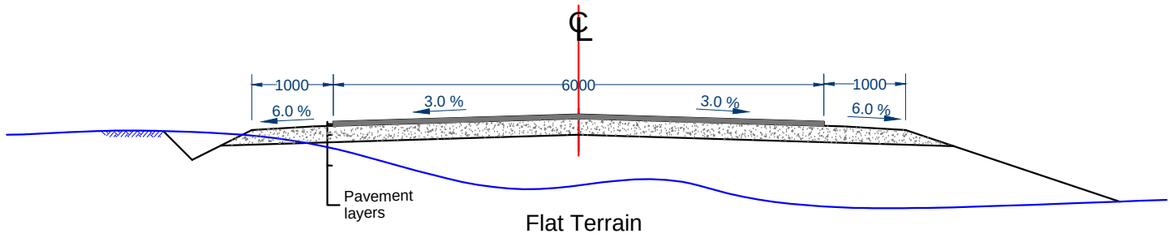
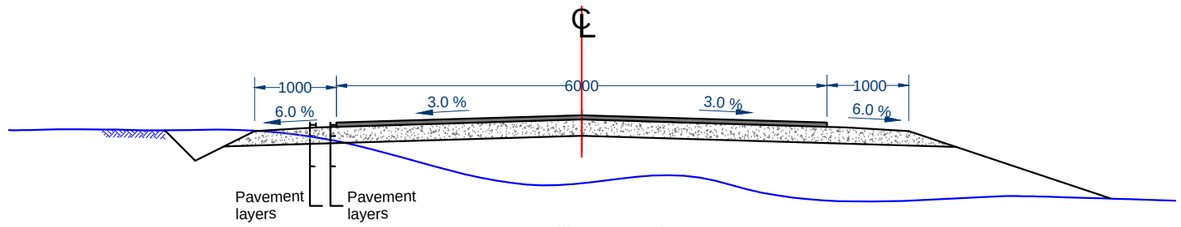
DC2, PAVED TYPICAL CROSS SECTION (RURAL)

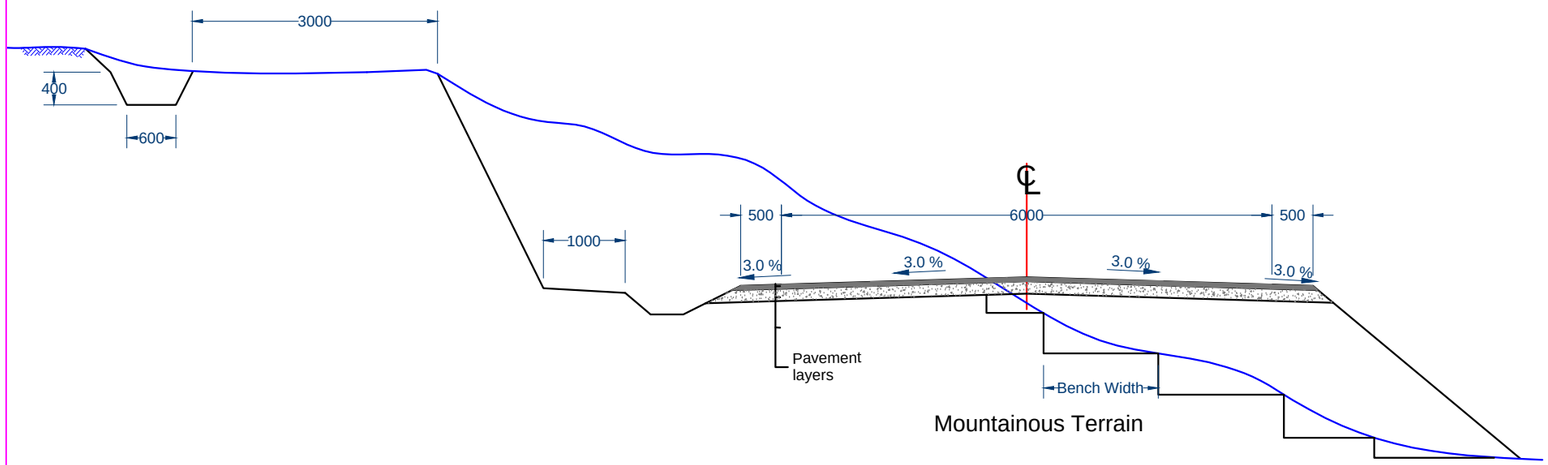
DRAWN		SCALE: 1:75 (at A3)	DRAWING NUMBER
DESIGNED			W-08E
CHECKED		DATE: December 2011	
APPROVED	B. JEBESSA		
EDITED	S. KIRSTEN		



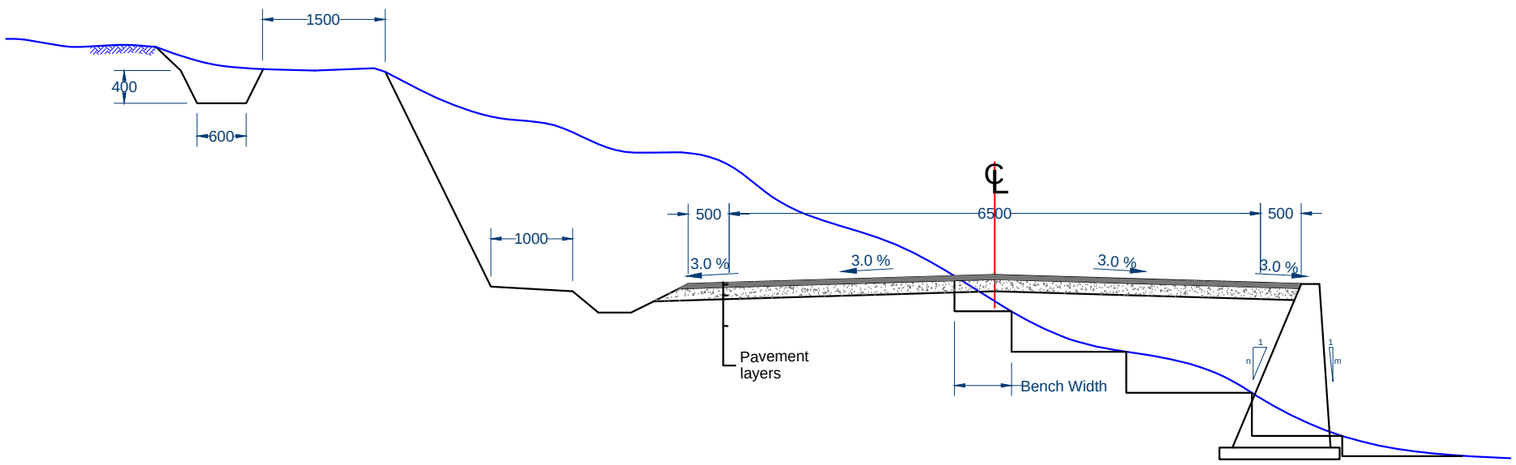
Flat Terrain



Rolling Terrain



Mountainous Terrain



Escarpment Terrain

Slope Ratio Table

Material	Height of slope	Side slope		Back slope	Safety classification
		Cut	Fill		
Earth	0.0 - 1.0	1:2	1:4	1:3	Recoverable
	1.0 - 2.0	1:2	1:3	1:2	Not recoverable
	> 2.0	1:2	1:2	1:1.5	Critical
Rock	Any height	Dependent on cost			Critical
Expansive clay [1]	0.0 - 1.0	1:2	1:4	1:3	Recoverable
	1.0 - 2.0	1:2	1:3	1:2	

Note:-

[1] Certain soils may be not stable at 1:2, geotechnical advice required.

Drainage ditch should be moved away from the embankment.

Note:-

1. All dimension in mm.
2. V-shaped is the standard shape for the drainage ditch constructed by grader.
3. Trapezoidal drains are commonly used and are much easier to dig and clean using labour-intensive methods. The minimum recommended width is 400mm.
4. In case of deep cut more than 10m, benching is recommended.
5. Use benching for ground traverse slope of 25% and more.
6. Benching on fill section shall be provided for transverse cross slope of the ground more than 25 % and the bench width shall be minimum of 2.5m.
7. Refer Drawings D-06 and D-07 for ditch detail.

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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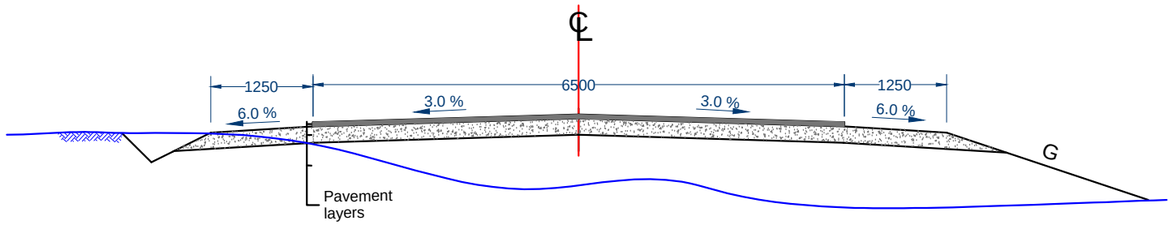
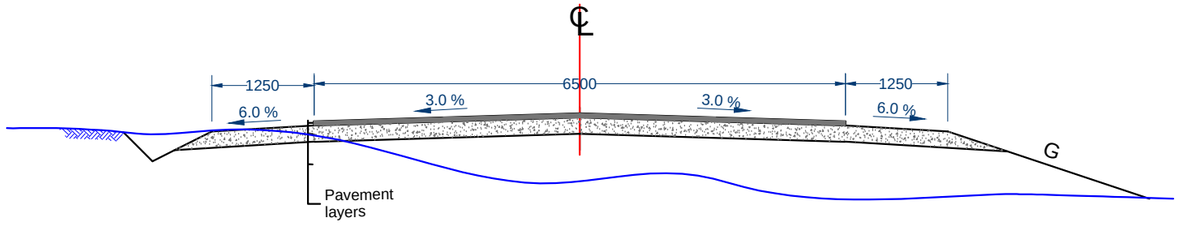
DC3, PAVED TYPICAL CROSS SECTION (RURAL)

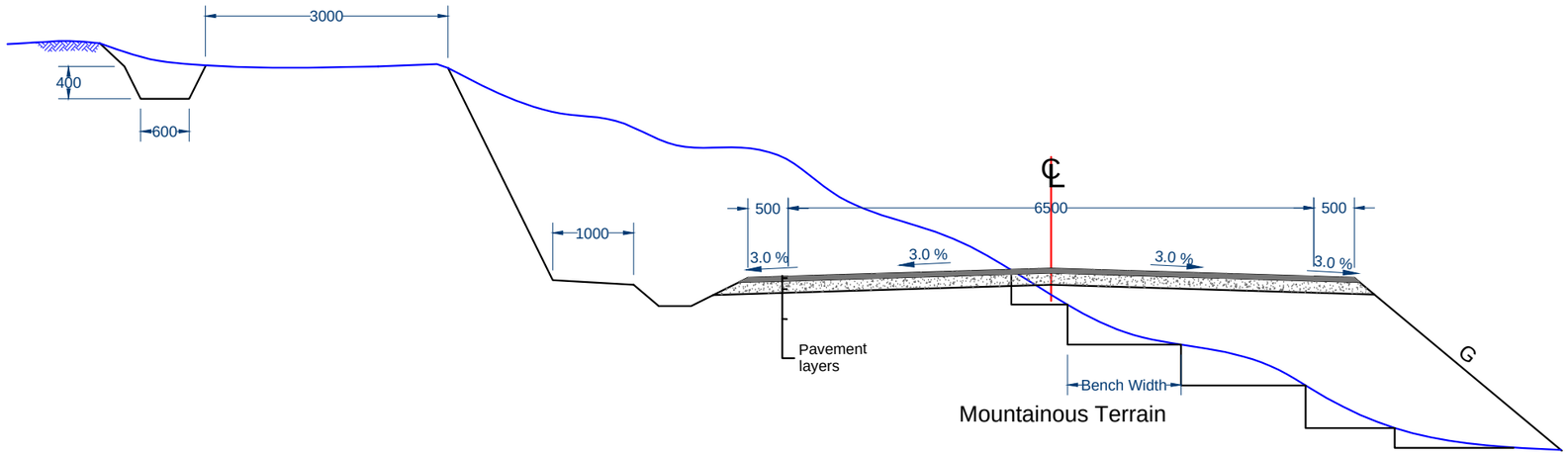
DRAWN		SCALE: 1:75 (at A3)	DRAWING NUMBER
DESIGNED			W-08F
CHECKED		DATE: December 2011	
APPROVED	B. JEBESSA		
EDITED	S. KIRSTEN		



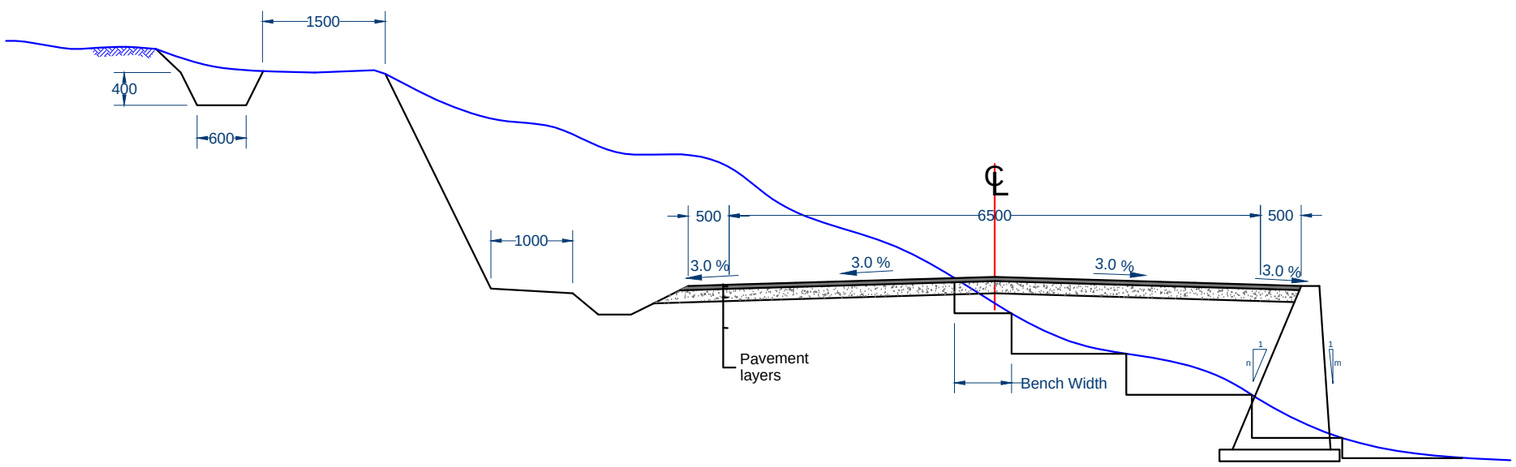
Flat Terrain



Rolling Terrain



Mountainous Terrain



Escarpment Terrain

Slope Ratio Table

Material	Height of slope	Side slope		Back slope	Safety classification
		Cut	Fill		
Earth	0.0 - 1.0	1:2	1:4	1:3	Recoverable
	1.0 - 2.0	1:2	1:3	1:2	Not recoverable
	> 2.0	1:2	1:2	1:1.5	Critical
Rock	Any height	Dependent on cost			Critical
Expansive clay [1]	0.0 - 1.0	1:2	1:4	1:3	Recoverable
	1.0 - 2.0	1:2	1:3	1:2	

Note:-

[1] Certain soils may be not stable at 1:2, geotechnical advice required.

Drainage ditch should be moved away from the embankment.

Note:-

1. All dimension in mm.
2. V-shaped is the standard shape for the drainage ditch constructed by grader.
3. Trapezoidal drains are commonly used and are much easier to dig and clean using labour-intensive methods. The minimum recommended width is 400mm.
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6. Benching on fill section shall be provided for transverse cross slope of the ground more than 25 % and the bench width shall be minimum of 2.5m.
7. Refer Drawings D-06 and D-07 for ditch detail.

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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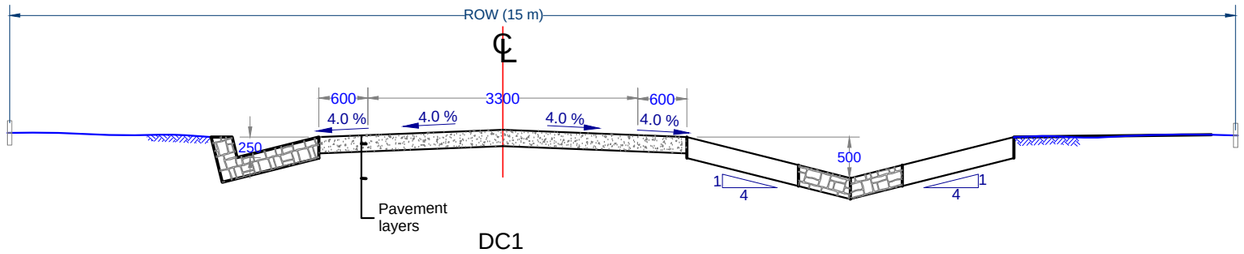
DC4, PAVED TYPICAL CROSS SECTION (RURAL)

DRAWN	SCALE: 1:75 (at A3)	DRAWING NUMBER
DESIGNED		W-08G
CHECKED		
APPROVED B. JEBESSA	DATE: December 2011	
EDITED S. KIRSTEN		



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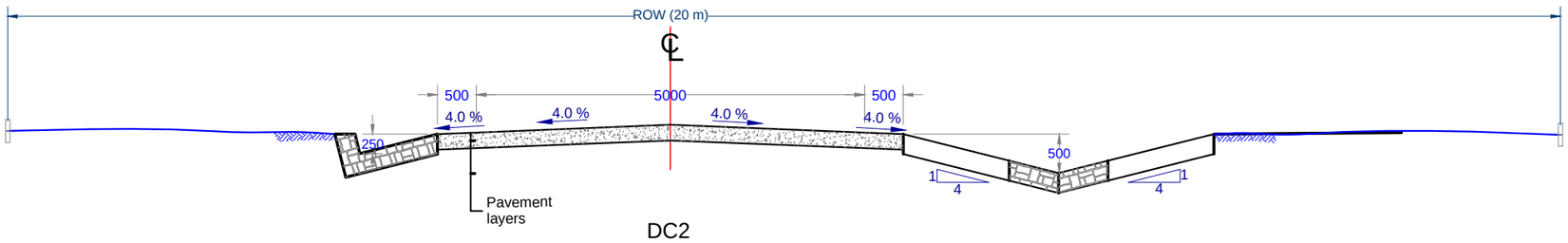

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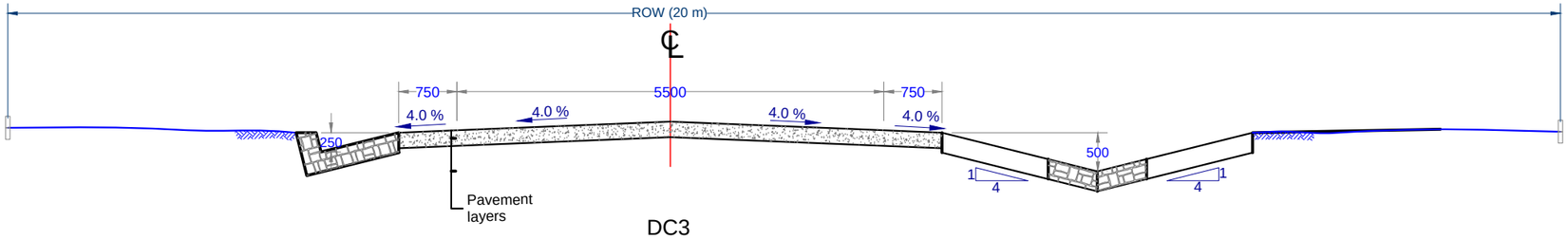
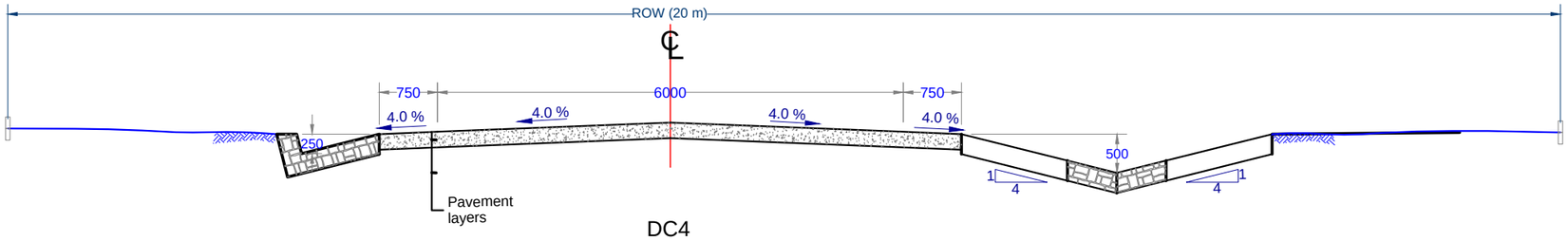


DC3



DC4

Note:-

1. Refer Drawings D-06 and D-07 for ditch detail.

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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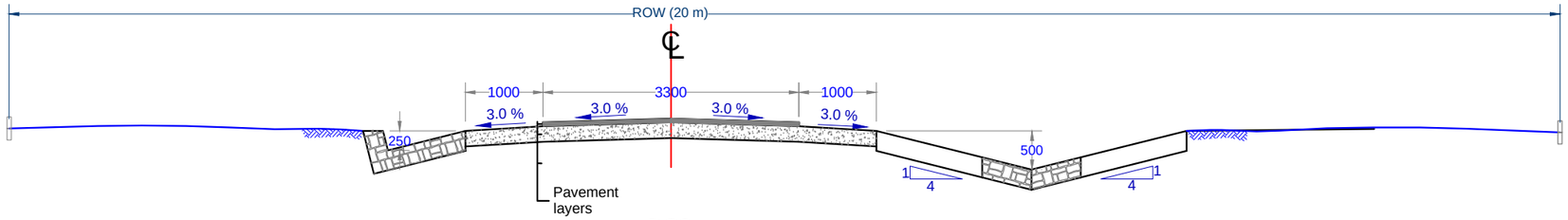
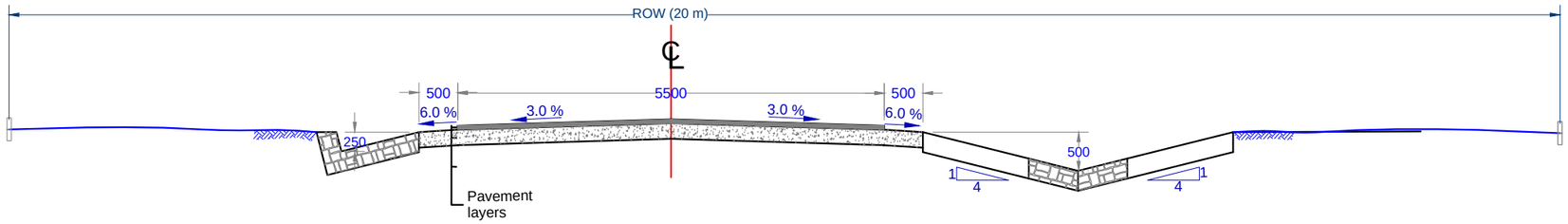
TOWN/VILLAGE TYPICAL CROSS SECTION (UNPAVED)

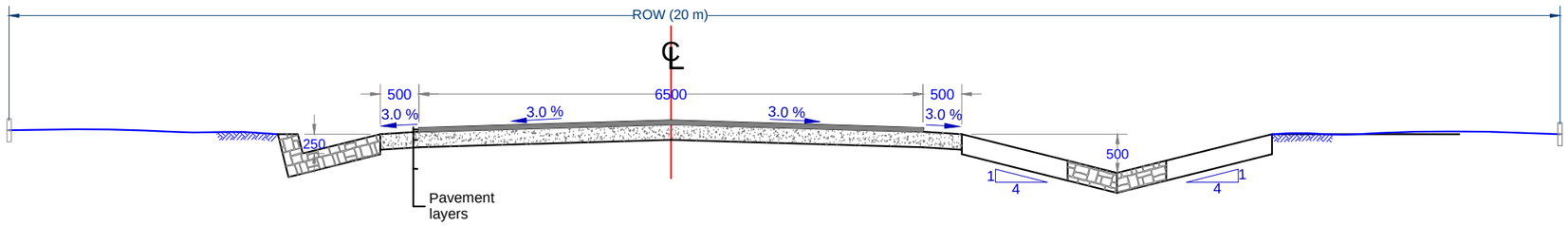
DRAWN		SCALE: 1:75 (at A3)	DRAWING NUMBER
DESIGNED			W-08H
CHECKED		DATE: December 2011	
APPROVED	B. JEBESSA		
EDITED	S. KIRSTEN		



DC2



DC3



DC4

Note:-

1. Refer Drawings D-06 and D-07 for ditch detail.

NO.	DATE	ENG. BY	SUBJECT	DRAWN BY	APPROVED BY
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TOWN/VILLAGE TYPICAL CROSS SECTION (PAVED)

DRAWN		SCALE: 1:75 (at A3)	DRAWING NUMBER
DESIGNED			W-08I
CHECKED		DATE: December 2011	
APPROVED	B. JEBESSA		
EDITED	S. KIRSTEN		